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Memoirs of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
VOL. X. NO. 3.

R E S U L T S

O F A N EXAMINATION O F

SYRIAN MOLLUSCAN FOSSILS,

CHIEFLY FROM THE RANGE OF MOUNT LEBANON.

BY CHARLES E. HAMLIN.

WITH SIX PLATES.

CAMBRIDGE:
Printed for the Museum.
APRIL, 1884.

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INTRODUCTION.

By the favor of Rev. SELAH MERRILL, D.D., during the years 1875-77 Archaeologist of the American Palestine Exploration Society, and now United States Consul at Jerusalem, the Museum of Comparative Zoölogy has recently become possessed of two small collections of Syrian molluscan fossils, chiefly from the range of Mount Lebanon. The one was made by Dr. Merrill himself, while prosecuting his work of exploration; the other, by Mrs. Bird, wife of Rev. William Bird, a missionary of the American Board of Commissioners for Foreign Missions, who with his family has been for many years stationed at Abeih, fifteen miles southeast of Beirût and among the mountains. As a large proportion of these fossils belong to species hitherto undescribed, and as others, of species already named, are better specimens of the same than those which were the basis of the original figures and descriptions, it has seemed desirable that the collections should be studied, and the results of the examination published.

Among the stores of the Museum of Comparative Zoölogy, a third small collection of fossil shells has been found, which is understood to be from "Lebanon," and to have been forwarded, perhaps presented, in 1866, by Rev. W. M. Thomson, D.D., author of the well-known work, "The Land and the Book,"—for more than thirty years missionary in Syria, and at the date specified acting United States Consul at Beirût. The material for investigation thus furnished has been increased, through the kindness of the officers of the Congregational House in Boston, by the loan of some interesting specimens, labelled "Mount Lebanon," which are preserved in the Museum of the American Board.

Unfortunately, however, as is usual with collections made by other than experienced or professional hands, notes are wanting of the exact localities with a few exceptions, and of the nature and position of the strata without exception, from which the fossils of the several lots were taken. This deficiency renders it necessary to state here how far the localities represented by the different collections can be identified.

Dr. Merrill's collection was put into my hands by himself, bearing labels to distinguish specimens found at points outside of the district where the greater part were procured, and for the rest a written statement was made, at my request, that "almost all the

specimens came from the vicinity of Beirût, Abeih, Dog River (Nahr el Kelb) a few miles north of Beirût, and the mountains between this river and the Cedars, a mountainous district which extends more than twenty and not over thirty miles north and south, with Beirût and Dog River as a centre." To this portion of country I shall refer for convenience, in the following pages, as the Beirût district.

The Bird collection was received also from Dr. Merrill in person, with the oral statement that, as he understood, it was gathered at Abeih and in its vicinity. The fact that some of the shells are of species already recorded as from that locality, and that the rock material which makes up the fossils, adheres to them, or fills their interiors, is such as is known to characterize the richly fossiliferous strata of Abeih, constitutes strong internal evidence that most of the specimens are actually from the place from which they are said to come. Yet under the title Jurassic Ammonites (pages 9, 10) reasons are given for the conclusion that the three species from the Bird collection there named could not have come from Abeih, where only Cretaceous strata are known to occur, but must have been taken from beds older than the Cretaceous, such as in all Syria, so far as at present traced, are restricted to one narrow area, lying entirely without the circle of Beirût, and upon the slope of Mount Hermon.

Of the Thomson and Congregational House collections it can only be affirmed that they are from "Lebanon," but the testimony of the specimens themselves goes to make it very highly probable that all of them had their origin within what we have termed the Beirût district.

Of the fossils brought together from these different sources, as in the case of all other collections from the same region of which any accounts have been published, it is mainly the Gasteropods that have been preserved in any considerable degree of completeness. Such specimens characterize the Bird collection, made up principally of choice things selected apparently under the guidance of a taste which rejected whatever was displeasing to the eye. But of the greater number of Lamellibranchs, interior casts alone occur; and taking into account the like condition of things in other collections from the same strata, and the nature of the beds in which they are enclosed, the probability seems very small that of certain genera better representatives will ever be discovered.

In dealing with such specimens, one is at once confronted with the question how far it is useful — not to say *allowable* — to attempt the description of species from well-preserved casts which bear positive generic characters, but exhibit few of the superficial markings upon which the distinctions of species largely depend. While settling for himself this question, the student is likely to remember the censure which has been unspareingly visited upon several eminent palaeontologists for presuming to confer specific names upon casts denuded of their tests, nor will he forget that later investigation has in signal instances justified their action.

The question is, perhaps, one of more interest in the study of molluscan fossils of the Cretaceous period, than with reference to those of any other. For while, for example, in determining the Cretaceous shells of Southern India and those of California and the Upper

Missouri country, Stoliezka in the first case, and Meek and Gabb in the others, had sufficient supplies of excellent material, able investigators have not seldom been reduced to the alternative of drawing conclusions from bad material, or of reaching no conclusions at all. This consideration, it seems to us, has not had due weight in forming the verdict which has been pronounced upon the work of Conrad as the first describer of Syrian fossil shells in any considerable number. The collections of the Lynch Palestine Expedition, and the other material which fell into Conrad's hands, were of very inferior quality; and if he were to name species, he was compelled to found them upon imperfect specimens, for he seems to have had no others. It was his further misfortune that the descriptions published in the Official Report of the expedition are meagre beyond the habit of their author, and that his figures, through fault of the artist, were poorly executed. From these several causes has resulted uncertainty concerning the identity of some of his species, and respecting the validity of others.

The Swiss Cretaceous Mollusca, described by Pietet and Campiche, afford a case not unlike that with which Conrad had to deal. These authors have been justly criticised for naming from casts so many species of the *Venerida*, a family in which the shells have often at the beaks and margins such thickness that it is impossible from the cast to reconstruct the exterior. But familiarity with the large Campiche collection (now in the Museum of Comparative Zoology) of molluscan fossils from the Cretaceous of Sainte-Croix, in which scores of specimens of the same species are but repetitions of like defective casts, obliges me to think that, if species are to be discriminated in the fossils of that locality, it must be by means of imperfect casts, for, with few exceptions, better examples are unknown.

Again, in his *Études Critiques sur les Mollusques Fossiles, — Monographie des Mydes*, — the late Professor Agassiz instituted, chiefly upon the basis of naked casts taken from the Swiss Cretaceous strata, a series of new genera and species, of which the major part has stood the test of later discovery and criticism. That distinguished observer saw that in the family of *Myidae* as limited by him (since in large part transferred to the *Pholidomyidae* and *Anatinidae*) the casts of his new genera indicated unmistakably that the shell must have been very thin, and that it was safe from the casts to infer the superficial character of the shells themselves, and that "those features, which are included in the terms *general figure and ornaments of surface*, acquire in the *Myidae* [so limited] an increased degree of importance from their invariable persistence and distinctness of design, in a similar ratio that the hinges and their characters have degenerated in value." (Morris and Lyett, Mollusca from the Great Oolite, Part II, p. 99.)

So too among Gasteropods, by the introduction of the genus *Tylostoma* Sharpe relieved that of *Natica* from a burden impossible longer to be borne, and to-day are accepted as valid, not only the genus, but the species, which he founded thirty-five years since on no other basis than casts from the Cretaceous strata of Portugal, of which he says: "Few of the specimens found retain any portion of the shell, and in no instance was I fortunate enough to find a shell perfectly preserved, so that the specific descriptions are necessarily

imperfect." (Quarterly Journal of the Geological Society of London, V, p. 376, 1849.) And, in general, where better material cannot be obtained, if species are named with proper care and discrimination from casts distinctly recognizable as to their genera, well preserved, and possessing some striking and characteristic features, due regard being had to the nature of the test in the group to which they belong, it would seem that such species may be useful in studying the relations of the different beds in which they occur.

The foregoing remarks, however, have been suggested by general considerations more than by the demands of the work here recorded, as will appear from the following statement. Of the fossils subjected to examination, the most obscure casts, Gasteropods as well as Lamellibranchs, whose generic relations cannot be affirmed with certainty, are passed over without notice, except two species which are simply figured and referred to as indeterminate. Fourteen species of Gasteropods are described as new, of which all the specimens used for the descriptions and figures, retain the shell, and generally in satisfactory condition. Of sixteen new Lamellibranchs, ten species are described and figured from specimens bearing the shell, and of the other six, based upon casts, three are species of the thin-shelled *Pholadomyidae* and *Anatinidae*; and concerning only one of the three remaining can there be any doubt, if specimens of the species shall be found hereafter with the test preserved, that both shell and cast can be readily identified as of the same species, thus involving neither confusion nor unnecessary change in specific names. We have to regret the disadvantage under which we have labored,—shared with many predecessors in paleontological study,—of having been obliged in some instances to describe a species from a solitary example.

Age of the Strata from which the Fossils were derived.

Botta's *Observations sur le Liban et l'Anti-liban*, published in 1833 (Mémoires de la Société Géologique de France, 1, pp. 135–160), give the results of the first geological exploration of the region to which they relate. The sections in detail, and the geological plan, which accompany this excellent memoir, are still regarded as giving a correct idea of the actual succession of formations in the mountain chains. But concerning the age of those formations a change of opinion has followed upon later investigations. The rocks and fossils collected by Botta were submitted to Ami Boué, a learned geologist of his time and secretary of the Geological Society of France. Having made a comparative study of the specimens, with the aid of European collections, Boué came to the conclusion that the three *terrains* of Lebanon recognized by Botta correspond to the Upper Jurassic, the Greensand, and the Lower Chalk of European systems.

In 1837 Heinrich von Schubert and Professor Roth visited Palestine, made a great number of geological observations, and described various fossil beds in the Lebanon and Anti-Lebanon ranges. Roth took back with him to Germany many fossils. About the same time Russegger, an Austrian Councillor of Mines, made extensive journeys in Egypt, the Soudan, and Syria, including Lebanon and Anti-Lebanon. His opinions for a time were widely adopted, but were afterward discarded, and call for no further notice.

In 1848 occurred the "United States Expedition to Explore the Dead Sea and the River Jordan," of which the Official Report by the commander of the expedition, Lieutenant Lynch, was published in 1852. This report includes that of Dr. Anderson upon the Geology, and that of Mr. Conrad upon the Palaeontology, of the parts explored. Besides the shells collected by the expedition, Conrad described some others from the same region which were furnished by individuals. He made by far the larger number to be Jurassic forms, and the rest Cretaceous. His determinations are considered as having misled Dr. Anderson in his decisions upon the geology of the country.

In 1864 the Due de Luynes accomplished his Geological Exploration of the Dead Sea, accompanied by Louis Lartet as geologist, who during the next two years published his observations in several papers, printed in the *Bulletin de la Société Géologique* and the *Comptes Rendus*; and from 1869-72 appeared in the *Annales des Sciences Géologiques* his *Essai sur la Géologie de la Palestine et des Contrées avoisinantes*. There followed, in 1875, a folio volume, which includes his earlier memoirs, revised and enlarged. In the chapter devoted to the Palaeontology of the Cretaceous formation is a list of molluscan fossils previously known from Palestine and Lebanon, and several new species are described and figured.

In 1867 Professor Oscar Fraas, of Stuttgart, published an important work, being Part I of his *Aus dem Orient*, the record of geological observations made by him in Egypt, the Sinaitic peninsula, and the environs of Jerusalem. In 1877 his *Juraschichten am Hermon* was issued, in the *Jahrbuch für Mineralogie*, etc., pp. 17-30, and the next year *Geologische Beobachtungen am Libanon*, or Part II of *Aus dem Orient*. The two parts taken together supply a full catalogue of all molluscan fossils known from Syria up to 1878, including, besides Conrad's recognizable species, European species of Lamarck, Sowerby, d'Orbigny, and others, as well as a considerable number described by Fraas himself. That part of the list found in Part I had been quoted in Lartet's folio of 1875. On comparing the lists of Conrad, Lartet, and Fraas, it will be seen that the number of new species from Syria, published since the date of Conrad's report, is not large. Of those described by Fraas, sometimes too briefly for ready identification, only very few seem to have been figured.

The most important consequence of the labors of Lartet and Fraas is the change of view which they have brought about with respect to the age of the stratified rocks of Palestine and the Lebanon region. It is now an established fact, that the great Cretaceous system which, stretching in Northern Africa through Morocco and thence eastward to Egypt, and southward into the Sahara and the Libyan Desert, crosses over into the peninsula of Sinai, spreads also over the greater part of Palestine and the ranges of Lebanon and Anti-Lebanon, and probably prevails east of the Jordan and the Dead Sea, in Gilead, Moab, and Idumaea. The earlier explorers seem to have been misled by the strong external resemblance of the light-colored limestones which they observed in Palestine to the rocks of the White Jura of Europe, and therefore regarded them as Jurassic.

In all Palestine proper, the Lebanon range, Coele-Syria (the Būkāa), and the Jordan valley southward to Akabah, there had been found up to 1878, upon the authority of

Fraas, no trace of any stratified rocks older than the Cretaceous formation. The *Geologische Skizze einer Reise durch Palästina und das Libanongebiet** of Professor G. vom Rath, published in 1881, makes good to that date the above statement of Fraas. But at Mejdel esh Shems, a village situated at an elevation of 1,340 meters upon the south-easterly slope of Mount Hermon,—the southern extremity of Anti-Lebanon,—Rev. Edwin R. Lewis, late Professor of Chemistry and Geology in the Syrian Protestant College at Beirut, discovered and identified what Fraas styles a mere "strip" or "patch" (*fleck*) of true Jurassic strata. Of this remarkable exposure of steeply tilted beds, interposed between Cretaceous rocks, one layer, a light-colored, efflorescent calcareous marl, extends upwards, forming the highest point of Mount Hermon, where Professor Lewis collected specimens of *Rhynchonella laevis* Schlotheim sp., a characteristic fossil of the Oxford Clay in Germany and France, and found at the lower level of Mejdel esh Shems in countless numbers. The layer of most importance in connection with the collections here considered is a "gray-black clay," a meter and a half thick, which imbeds the Jurassic Ammonites presently to be noticed,—species before known from the Ornati Clay of the uppermost Brown Jura of Europe. It seems altogether probable that more detailed exploration of this highly interesting district will reveal other outcrops of Jurassic strata.

The publications of Professor Fraas have been our only means of fixing with any degree of certainty the stratigraphic position of the various species enumerated in the following pages. That distinguished geologist in his earlier journey satisfied himself that the whole line from Jaffa to the Dead Sea passes over strata which belong to the Turonian and Senonian stages of the Upper Cretaceous, in this respect confirming the previously formed conclusion of Lartet. The Cretaceous strata of Lebanon are divided by Fraas into nine stages, or zones, as follows:—

1. The Glandarius zone, consisting of Dolomite, Marble, and Oölite, with clayey inter-layers, marked by *Cidarites glandarius*.
2. The Sandstone stage, with *Trigonia Syriaca* and *Astarte Libanotica*. With this division the eruptive Melaphyrs are closely associated; and to it also belong the coal-beds which occur in the spring-district of the Nahr el Beirut.
3. The Gasteropod zone of Abeih: † Limestone, Marl, Dolomite, with *Nerinea*, *Cerithia*, and *Turritellae*.
4. The Cardium bed: brown Limestone strata with casts of *Cardia*.
5. The zone of *Ammonites Syriacus*, two hundred meters thick, consisting of gray Limestones, containing *Pteroceras*, *Hippurites*, *Orbitulinae*, *Ostreae*, etc.

* Verhandlungen des Naturhistorischen Vereines der Preussischen Rheinlände und Westfalens, XXXVIII, pp. 66–114, Bonn, 1881.

† This summary of the nine zones is substantially that presented by vom Rath (op. cit., p. 103). By comparison with page 13 of this memoir, it will be observed that the thick bed of Sandstone (forty meters) there noticed as lying at the base of this zone is not here mentioned. Is the omission an error, or due to the fact that the Sandstone is not fossil-bearing, and so not an essential part of the zone?

6. The Radiolite zone: Cretaceous Marl, crystalline Limestone, Dolomite, fissile Limestone.

7. The Slate of Hakil: Hard fissile Slate, with Fishes, Crabs, Sepiae, and Echinoderms.

8. Marl, with the Fishes of Sâhil Alma.

9. Chalky Marl, corresponding to the English White Chalk.

Of these members, 1 and 2 belong to the Cenomanian, 3–8 to the Turonian, and 9 to the Senonian of d'Orbigny. Three of them, not to be referred to again, are represented in the Bird collection by other than molluscan species, viz.: the 1st, by the singular spines of *Cidarites glandarius* Lang (*Cidaris glandifera* Goldfuss), the *Lapides Judæi*, or "Jews' Acorns," "Stone Olives," etc., which, with the Lebanon fossil fishes, were objects of curiosity and wonder to early Oriental travellers from the times of the Crusades; the 7th, by small specimens of two genera of Echinoids, *Salenia* and *Cyphosoma*; the 8th, by Fossil Fishes from the Marl of Sâhil Alma.

Of the Tertiary formation, Fraas agrees with Lartet in recognizing in Syria south of Tarâbulûs (Tripoli) the presence of only the Eocene; but he declares it to be impossible to draw the limit between the Eocene and the Cretaceous. He states that Nummulites pass down into the Cretaceous, and asserts, contrary to the doctrine so long accepted, that nowhere in the region does the finding of a Nummulite make it certain that the bed in which it lies is of Tertiary age; while Lartet apparently adheres to the older view. The Bird collection contains specimens of what Lartet regards as *Nummulites Lyelli* Archiac.

Lartet declares the presence of the Miocene, so fossiliferous near Cairo and on the isthmus of Suez, as well as of the Pliocene, not proved by the evidence of fossils to exist in the parts traversed by himself. But he is inclined to assign to the Tertiary, without specifying the age more precisely, certain detrital deposits found in Palestine and Idumaea. Fraas, however, on an excursion to Mount Terbol (or Turbul), a spur from the northern part of the Lebanon range, a few hours' journey from Tarâbulûs, discovered a "surprising mass" of Tertiary detritus, resting upon a floor of yellow calcareous rock. In this limestone he distinguished bulky Corals, *Ostrea longirostris*, and many other fossils which warranted him in pronouncing the beds to be of Miocene age.

It may not be out of place to add, that during a brief interview with Professor Zittel, of Munich, after the determinations and descriptions noted in the following paper were mainly completed, his attention was called to the outspread specimens of the several collections. He did not hesitate to express his opinion that, as a whole, the Cretaceous portion must be regarded as of later than Cenomanian age. Though given after a hasty and general survey, this opinion is significant as being that of an eminent palaeontologist, and confirmatory of the view of an able and experienced geologist. It has weight, not only on account of Professor Zittel's reputation for great learning in the wide field of Palaeontology, but because the Cretaceous system has been an object of his special study.

SYRIAN MOLLUSCAN FOSSILS.

CEPHALOPODA.

THE few Ammonites included in the following list, being species which were long since described, are designated by the names applied to them in the works quoted in this paper. To substitute for the older and more familiar generic names those which have been introduced by the most recent investigators, would not subserve our present purpose.

JURASSIC AMMONITES.

Of the three species here presented, representatives of two are from Dr. Merrill, and were obtained by him at Mejdel esh Shems, a Druse village situated, as already stated, upon the southerly slope of Mt. Hermon, at an elevation of 1,340 meters, over which passes the frequented road from Baniâs to Damasens. The village stands upon a narrow strip of Jurassic rock, the only exposure of that formation up to a recent date discovered in Syria. The Ammonites found in this vicinity are all recognized European Jurassic forms, and the three here presented, with some others, occur in a bed of what is known to German palaeontologists as the *Ornati Clay*, part of their uppermost *Brown Jura*, and nearly equivalent to the *Oxford Clay* of the English *Middle Oölite*.

The fact that these species have been hitherto known as occurring in Syria only at this single locality, leads to the inference that the specimens received from Mrs. Bird were derived from it, though they came as part of a collection purporting to have been made in Abeih and its vicinity.

where only Cretaceous strata have as yet been detected. The inference is justified by the identity of mineral character observed in the specimens from both the Merrill and Bird collections. All are pyritiferous, and bear externally a bright metallic gloss, mentioned by Fraas as marking the Ammonites of this bed of Ornati Clay, which are, in his own words, *alle glänzend verkiest*.

It is known that the pupils of the mission stations established at Mejdel esh Shems and Abeih are encouraged by their teachers to gather up the fossils which abound in both districts, and that by them has been brought together a large part of the fine collection now exhibited in the college at Beirût. It was probably from the station at Mejdel esh Shems that these Jurassic Ammonites were procured.

The specimens are all in excellent condition, generally retaining the delicate test, which is, however, in some instances removed or worn thin, so as to show the complicated lobes of the septa.

In accordance with the foregoing statement, all may be considered as coming from Mejdel esh Shems and the Ornati Clay.

Ammonites convolutus SCHLOTHEIM.

? *Nautilus polygyrus* REINECKE, 1818, Nautili et Argonautæ, p. 73, Pl. v, figs. 45, 46.

Ammonites convolutus SCHLOTHEIM, 1820, Petrefactenkunde, p. 69.

Ammonites convolutus ornati QUENSTEDT, 1849, Cephalopoden, p. 168, Pl. xiii, fig. 1.

Six specimens. The largest, having a diameter of 24 mm., width of last whorl, 9 mm., thickness of same, 9 mm., answers well to Quenstedt's figure, and precisely to that of Loriol and Pellat (Monogr. des Étag. sup. de la Format. Jurass. de Boulogne-sur-Mer, p. 35, Pl. i, fig. 18), which represents an example from Baden, at first "faussement attribuée à l'Am. *Quchenensis*" Loriol, 1873, but, it is added, "qui appartient au group de l'Am. *polygyrus*." The ribs of this specimen curve forwards more than do those of the species *communis* Sow. and *plicatilis* Sow., while they are finer than in the former and coarser than in the latter. Many of the ribs are trifurcate as they pass over the back; others are bifurcate. Coll. Bird.

There are, besides, five much smaller specimens, varying in diameter from $12\frac{1}{2}$ mm. down to 8 mm., and which I take to be the young of this species. These are from Dr. Merrill, who obtained them at Mejdel esh Shems.

Ammonites hecticus (REINECKE) HARTMANN.

Nautilus hecticus REINECKE, 1818, Nautili et Argonautæ, p. 79, Pl. iv, figs. 37, 38.

Ammonites hecticus HARTMANN, 1830, Versteinerungen Württembergs, p. 21

- " " BRONN, 1835-37, Lethaea Geog., p. 428, Pl. xxii, fig. 9 *a*, *b*-10 *a*, *b*.
- " " D'ORBIGNY, 1842, Paléont. Frang., Terr. Jurass., I, p. 432, Pl. clii, figs. 1-5.
- " " QUENSTEDT, 1849, Cephalopoden, p. 117, Pl. viii, figs. 1 *a*, *b*.
- " " QUENSTEDT, 1858, Der Jura, p. 541, Pl. lxxi, figs. 21, 22.

Six specimens. Dimensions of four:—

1.	Diameter, 30 mm. ; width of last whorl, 13 mm. ; thickness of same, 7 mm.
2.	" 27 mm. ; " " 13 mm. ; " " 7½ mm.
3.	" 26 mm. ; " " 13 mm. ; " " 7 mm.
4.	" 26 mm. ; " " 12 mm. ; " " 7 mm.

Examples 1 and 4 agree well with figures of Bronn and Quenstedt, and with fig. 4 of d'Orbigny; while 2 and 3 seem to represent var. *lunula*, as figured by Bronn, op. cit., Pl. viii, figs. 2 *a*, *b*. Coll. Bird.

Two specimens, smaller than 1-4 and obscurely marked, are probably of this species, of which two varieties are recognized. These were obtained at Mejdel esh Shems, and are from the Merrill collection.

Ammonites fuscus QUENSTEDT.

Ammonites fuscus QUENSTEDT, 1858, Der Jura, p. 475, Pl. lxiv, figs. 1-3

Single specimen. Diameter, 26 mm. ; width of last whorl, 14 mm. ; thickness of same, 11½ mm.

In size, proportions, and markings it agrees perfectly with Quenstedt's figure 1. Umbilicus very small, each successive volution almost wholly covering that which precedes. Coll. Bird.

CRETACEOUS AMMONITES.

Ammonites Syriacus VON BUCH.

Ammonites Syriacus, L. VON BUCH, 1819, Ueber Ceratiten, p. 20, Pl. vi, figs. 1-3.

" " CONRAD, 1852, Official Report, p. 221, Pl. xiv, fig. 74.

Three specimens. Dimensions of largest (uncommonly fine, and retaining the thin test almost entire): diameter, 52 mm. ; thickness, tubercles included, 23 mm. ; width of outer whorl at aperture, 25 mm.

Localities.—On the authority of Dr. Merrill, two specimens are from the “Gilead Mountains,” east of the Jordan, and from his collection. The third, of which the dimensions are given above, is from Abeih or its vicinity, and from the Bird Collection.

Stratigraphical Position.—Fraas regards the marl, of which this species is the characteristic fossil, as marking the close of the Brown Chalk of German systematists, and as introducing the superimposed Gray Chalk. This marl and beds of some 170 meters in thickness which lie next above, he terms the *Zone of the Ammonites Syriacus*, in his view the third member (ascending) of the Turonian subdivision of the Cretaceous, as developed in Syria. According to the same authority, three zones more follow above before the close of the Turonian and the commencement of the Senonian marl, corresponding to the White Chalk. We may then consider this species as belonging to the middle portion of the Turonian of d'Orbigny, though that author himself (*Prodrome*, II, *Étage vingtième*, 11) referred it to his Cenomanian (Upper Greensand), which next precedes his Turonian.

Ammonites Vibrayeanus D'ORBIGNY.

Ammonites Vibrayeanus D'ORBIGNY, 1840, *Paléont. Franç., Terr. Crét.*, I, p. 322, Pl. xvi, figs. 1-3.

Eight specimens, interior casts. In the compressed and flattened form, thin, but truncate back, sagittate aperture, and general proportions, they correspond so closely to d'Orbigny's description and figures of the species above named, that I cannot hesitate to refer them to it. The best preserved of the eight fully accords with d'Orbigny's description in having straight ribs radiating from the umbilicus to the periphery. Yet it is to be noted that the septal lobes agree better with those of *A. Syriacus* than with the lobes of *A. Vibrayeans*, as figured by d'Orbigny.

It must be of similar, but probably more imperfect specimens, that Fraas remarks (*Aus dem Orient*, II, p. 78): “The choice becomes difficult whether we ought to reckon them with *Syriacus* or with *Vibrayeans*.”

Diameter of largest, 77 mm. The specimen mentioned above as the best preserved has the dimensions: greatest diameter, 68 mm.; greatest thickness, 19 mm.; width of outer volution at the aperture, 37 mm. Coll. Thomson.

Locality and Position.—Probably the Beirut district; from same horizon as the last species.

Ammonites Libanensis? CONRAD.

Ammonites Libanensis CONRAD, 1852, Official Report, p. 234, App., Pl. vi, fig. 46.

Fragment of the east of an outer whorl, apparently from the upper posterior portion of an individual of the species above named. Width of whorl, 60 mm.; thickness, 63 mm. Measured along the dorsal surface, the fragment has a length of 70 mm. It bears nine transverse ribs, little prominent and about as wide as the interspaces.

The specimen is too small a part of the whole fossil, and too imperfectly preserved, to admit of positive identification. Coll. Merrill.

Locality and Position.—Beirût district; probably from the same horizon as the last two species.

GASTEROPODA.

Of the species enumerated under this title, those designated as being from the Bird collection are from Abeih, or its vicinity, and agree in their rock material with the beds of Fraas's *Gasteropod zone of Abeih*, the lowest of six members which, according to his view, make up the Turonian stage of the Cretaceous of that region. At Chân Shamûr, near Abeih, a natural profile shows the zone to have seven subdivisions, of which there need be mentioned here only the lowest, a thick bed of red and yellow ferruginous sandstone, and two thinner and higher beds of yellow marl. The latter rock is spoken of as especially exposed at Abeih, and as yielding, through weathering, the well-preserved Gasteropods for which that locality is famous above all others of the region. Fraas's language implies, but does not definitely assert, that the marl only is productive of recognizable species. Our specimens show this marl to be for the most part soft and earthy, with intermingled bits of broken shells; but the rock material associated with our finest univalves from Abeih is arenaceous, composed indeed of calcareous—not siliceous—grains, and, like the earthy marl, ferruginous and mingled with the *débris* of shells. Were the sandstone above mentioned known by us to be friable and to furnish well-preserved shells, we should suppose the species in question to be from that portion of the zone. But in the absence of proof that the sandstone is thus prolific, we must regard them as coming probably from an arenaceous portion of the marl, and shall so refer to them.

The Gasteropods of the Thomson and Congregational House collections agree in rock material with those of the Bird collection, and were sent home from Beirut by American missionaries, one of whose principal stations is Abeih. It is therefore altogether probable that they were procured from that locality, since it yields the most abundant and attainable supply. But to guard against possible error, we will, in our discussion of the several species, speak of them as probably from the Beirut district, — already defined. The specimens of the Merrill collections, with a few exceptions, we know to be from that district.

Lunatia Gileadensis. sp. nov.

Plate I, fig. 1.

Testa ponderosa, globoso-turbinata: spira elevata, acutiuscula: anfractus circiter quinque rotundati, subito crescentes, prope marginem posteriorem subdepressi; sutura perspicua: apertura lata; labium postice calloso-reflexum: umbilicus aperitus angustior, perrius, sine funiculo.

Shell thick and heavy, globosely turbinated: spire elevated, rather sharp: whorls about five, rounded, slightly depressed at the posterior margin; suture well marked; aperture semilunar; columellar lip callously reflexed behind; umbilicus open, rather narrow, pervious, not funiculate.

Single specimen, with portions of the body-whorl broken away. Length, 87 mm., original length about 95 mm.; width, 76 mm., originally about 85 mm.

This species most resembles the recent *Lunatia heros* Say, differing from it chiefly in having a more elevated spire, and the body-whorl rather more produced anteriorly. The umbilicus is not narrower than is seen in many specimens of *heros*.

The specimen is completely silicified, and is incrusted without and within by a layer of siliceous concretions. The concretionary layer (perhaps deposited while the fossil lay in a cavity) is of moderate and uniform thickness, as is evident from the fact that the shell retains the just proportions of all its parts. The thickness of the outer lip and parts adjacent ranges from 7 mm. to 9 mm., as measured upon the fractured edge and along a section exposed by the removal of a triangular portion broken out in preparing the specimen, but cemented back in place before the figure was drawn. The shell must therefore have been originally of unusual thickness, far exceeding in this respect the most ponderous species of recent *Neverita*,

which, in fact, have the corresponding parts of the body-whorl always comparatively thin. Coll. Merrill.

Locality and Position.—Mountains of Gilead, east of the Jordan. Probably Cretaceous.

Natica Syriaca CONRAD

Natica Syriaca CONRAD, 1852, Official Report, p. 220, Pl. xii, fig. 70.

A single, small interior cast. Length, 43 mm.; width, 37 mm. Coll. Thomson.

Locality and Position.—Probably the Beirut district; from the yellow Turonian marl.

Amauropsis subcanaliculata, sp. nov.

Plate I, fig. 5.

Testa ovato-elongata; spira clata, fastigata, apice acuminata: anfractus septem, a lateribus appланati, postice angulati et gradatо-subcanaliculati; ultimus dimitidiam longitudinalinem testae paulo superans, ad angulum latissimum, prorsum contortatus denique productus: sutura pene linearis, vir impressa, margine exili ante crenulata: apertura longitudinalis, angusta, antice paucim attenuata: columella imperforata, callo obtecta.

Shell ovate-elongate; spire elevated, fastigate, apex acuminate: whorls seven, flattened on the sides, posteriorly rather roundly angulate and gradate-subcanaliculate; body-whorl a little exceeding half the total length of the shell, broadest at the angle, narrowing forwards and produced in front: suture almost linear and scarcely impressed, and bordered by a thin and slightly elevated rim rising from each successive whorl: aperture longitudinal, narrow, moderately attenuated in front; columella imperforate, apparently thinly overspread with callus.

Described from a single specimen retaining the test nearly entire. Length, 64 mm., originally about 66 mm.; width, 33 mm., original width about 35 mm.; length of body-whorl to suture, 34 mm.; length of spire, from suture of body-whorl, when entire, about 32 mm.

Comparison of the specimens named under the above and the next following title with a series of *Natica tubiformis* Sow. (*Buccinoides labyrinthicus* Schlotheim) from Sowerby's original Alpine Gosau locality, convinces me that the three species must be associated in the same ultimate subdivision, generic or subgeneric, whether that group be termed *Euspira* or

Amauropsis. As the application of the former name seems not yet to be definitely settled, I have for the present followed Zittel in assigning *bulbiformis* (and with it the other two species) to *Amauropsis*, though it may be questioned whether the name is justly applicable to any one of the three.

Besides the resemblance of the three species in general form, and in characters of mouth and spire, their striking similarity in the region of the suture is to be observed. In the several species each volution terminates behind in a more or less truncately flattened area, bounded within, next to the suture, by a thin and slightly elevated rim, and without, in two of the species, by a distinct, rounded, backward-projecting varix, which, with the internal rim, accompanies the area to the top of the spire. The space between the rim and the varix constitutes a canal, deep and flat-floored in *bulbiformis*; less deep and with bottom sloping outward, but sufficiently marked, in the present species; while in the following one it becomes a slightly concave shelf, bounded inside by the small but persistent sutural rim, and externally by the varix, present indeed but reduced to a minimum. In all three species is found the same lightly impressed and almost linear suture, the canalulation being wholly outside the suture proper and distinct from it.

Coll. Bird.

Locality and Position.—Abeih; from the arenaceous Turonian marl.

***Amauropsis gradata*, sp. nov.**

Plate I, fig. 3.

Testa late-orata; spira elevata, pyramidata, apice acuto; anfractus sex, a latere applicati, postice prope suturam acute angulati et late tabulati, spira speciem scalarum gerente; anfractus ultimus spira longior, latior quam longior, ad angulum latissimum, prorsum subito contractus; sutura linearis margine exili infra circumdata; apertura sublunata, antice producta et incurvata, postice biaugmentata; labrum simplex; columella excavata, rimatum umbilicalem exhibens.

Shell broadly ovate; spire elevated, pyramidal, having the apex acute; whorls six, flattened on the sides, behind near the suture sharply angled and widely tabulate, the spire showing the form of a winding staircase; last whorl longer than the spire, wider than long, broadest at the angle and thence rapidly diminishing forward; suture linear, bordered by a narrow margin slightly raised on each whorl; aperture sublunate, in front produced

and curved, posteriorly biangulate; outer lip simple; columella excavated, showing a chink-like umbilical opening.

This species is described from a single specimen of the following dimensions: length (nearly entire), 39 mm.; greatest width, 28 mm.; length of body-whorl slightly shortened, 21 mm.; length of spire, 18 mm. Coll. Bird.

Locality and Position.—Abeih; from the arenaceous portion of the Turoanian Marl.

Amauropsis Abeihensis, sp. nov.

Plate I, figs. 2 a, b.

Testa subglobosa; spira brevis, acuminata; anfractus sex, subconvexi, sutura angusta excavata sejuncti; ultimus valle inflatus, ad medium latissimus, latior quam longior; superficies striis incrementi crasse rotata: apertura obovata, dilatata, postice angustata, antice lata ac rotundata; labium tenui; columella rimata et ad terminacionem fureata.

Shell subglobose; spire short, acuminate: whorls six, subconvex, separated by a narrow but excavated suture; the last whorl greatly inflated, widest at the middle, broader than long; surface coarsely marked with striae of growth: aperture obovate, expanded, narrowed behind, in front wide and rounded; inner lip thin; columella fissured, and at the end forked.

Single specimen. Length, 24 mm.; length of last whorl, 18 mm.; width, 20 mm.

Like *Enspirula pagoda* Forbes, 1846 (Trans. Geol. Soc. Lond., VII, p. 136, Pl. xii, fig. 14), this specimen has the posterior edge of its volutions rounded and descending into a narrow canalicate suture. The spire is less elevated than in *pagoda*, and the last whorl is relatively much larger. The shell most resembles *E. spissata* Stoliczka (Cretac. Gast. of So. India, p. 303, Pl. xxii, figs. 3, 4), the body-whorl of which, however, has the surface punctate, is more gradate, being flattened behind and upon the sides near the suture, and is less ventricose. *Abeihensis* and *spissata* agree in proportions of spire and form of aperture, and both have the columella anteriorly flattened and distinctly grooved; but in *spissata* it is not fissured, while in the present species the groove ends behind in a chink-like umbilicus. *E. lirata* Sow. (also Cretaceous) differs from both the last mentioned species in having a deep and conspicuous umbilicus, as well as in other respects.

More nearly than *E. subcandidula* and *gradata*, the present species corresponds to the recent typical *Amauropsis* in the character of its suture and

spire, and seems therefore more appropriately to bear that generic name.
Coll. Bird.

Locality and Position. — Abeih; from the arenaceous portion of the Turo-nian marl.

TYLOSTOMA SHARPE.

This genus, instituted by Sharpe in 1849 (Quart. Journ. Geol. Soc. Lond., V, p. 376), is identical with *Varigera*, designated by d'Orbigny in 1850 (Prodr. de Paléont., II, p. 103). It is characteristic of the Cretaceous system in Portugal, from which Sharpe described four species. Pietet and Campiche have since named eight from the Cretaceous beds of Sainte-Croix, Switzerland, and still later (1867) Stoliczka has recorded three species from the Cretaceous of Southern India; but the genus has not been recognized hitherto among the fossils of Syria. It is assigned to the family *Naticidae*.

Tylostoma Birdanum, sp. nov.

Plate I, fig. 4.

Testa orato-elongata, subturrata; spira clata, conica, acuminata: anfractus septem convexi, vix gradati, striis incrementi crassioribus insigniti, varicibus exteris prope continuis in ordines duos fere oppositos reductis multi; ultimus longitudinem spirae paulo superans et talius quam longior; sutura profunda: apertura orato-lunata, antice rotundata, postice angulo acuto terminans; columella rimulata.

Shell ovate-elongate, subturreted; spire elevated, conical, acuminate: whorls seven, convex, very slightly tabulated at the posterior margin, marked with rather heavy lines of growth, and bearing two rows of nearly continuous variees, distant from each other about half a volution; last whorl but little longer than the spire and wider than long; suture deep: aperture ovate-lunate, rounded in front and terminating behind in an acute angle; columella slightly fissured.

The species is described from a single specimen of the following dimensions: length in present condition, 38 mm.; original length, approximate, 40 mm.; length of body-whorl restored, 21 mm.; its width, 27 mm.; length of spire measured from body-whorl, 19 mm.

The specimen here described is one of very few of its genus which have been found retaining the test. The only parts wanting are a small trian-

gular portion of the anterior extremity, a little of the outer lip, and a small oval patch on the dorsal side of the penultimate whorl, where is found a perforation into the interior of the shell. The specimen is remarkable for exhibiting well-marked external varices on the front of the three largest whorls, distinguishable also upon the back, but less perfectly preserved. They are remains of somewhat dilated margins of successive outer lips, directly within which occur the internal varices characteristic of the genus, but not visible in our example. In several species no traces are found of external varices, which therefore have been regarded as not of generic value, though in some instances they may have been worn away, as often happens to shells of *Scarabaeus*.

I have named this species after Rev. William Bird, missionary of the American Board, now and for many years stationed at Abeih. In the spire it closely resembles *T. Rochatium* Pietet and Campiche, from "l'Étage Aptien inférieur," (Deser. des Foss. du Terr. Crét. de Ste.-Croix, II, p. 356, Pl. lxxiii, figs. 12, 13,) which, however, is not known to have external varices, and is proportionally longer and narrower. Coll. Bird.

Locality and Position. — Abeih; from the arenaceous portion of the Turonian marl.

Tylostoma Syriacum CONRAD sp.

Plate I, figs. 6 a, b, and Plate II, fig. 10.

? *Chenopus Syriacus* CONRAD, 1852, Official Report, p. 220, Pl. xii, fig. 71.

? *Natica elatior** COQUAND, 1862, Géol. et Paléont. de Constantine, p. 179, Pl. iii, fig. 5.

? *Tylostoma fallax* PIETET and CAMPICHE, Sept., 1862, Foss. du Terr. Crét. de Ste.-Croix, II, p. 331, Pl. lxxiii, figs. 3, 4.

Five interior casts, of which three are very imperfect. Of the best two the following are the dimensions. The larger, Coll. Merrill (Pl. i, figs. 6 a, b): length, shortened at tip of spire, 83 mm.; original length, approximate, 92 mm.; width, compressed, 45 mm. The better, Coll. Thomson (Pl. ii, fig. 10): length, spire shortened a little, 70 mm.; original length, about 75 mm.; width, natural, 44 mm.

That the fossils to which I have assigned the name *Tylostoma Syriacum* may be identified with absolute certainty, comparison should be made with Conrad's type; but his Syrian types are not at present to be found. There

* In Coquand's *Études supplémentaires sur la Paléontologie Algérienne*, 1880, received since the above was written, the author has changed the name of his *Natica elatior* to *Tylostoma elatius*.

is reason to doubt the accuracy of his delineation of the specimen figured, which he styles "a cast somewhat distorted."

The examples on which my determination is chiefly based are the two casts measured above. Of each, five volutions remain,—two more seeming required to complete the larger, and one to complete the smaller.

The fossils included under the names placed above, as probably synonyms, agree in number of whorls, proportions, spiral angle, and (with trifling allowance for distortion) in form of aperture, and in respect to size quite as closely as would several adult individuals of one and the same species. From figures alone it seems impossible to establish tenable distinctions between them. They all differ widely from *Natica* in the following points. The aperture is much less oblique, and posteriorly terminates in an acute angle. The columellar lip is very nearly straight, and the body-whorl is proportionally too small and the spire too elevated for *Natica*.

The characters last enumerated indicate that these so-called species should be referred to the genus *Tylostoma*. Neither the figures nor our casts show, indeed, any impressions left by internal variees, a point upon which Pictet and Campiche remark, under their diagnosis of *Tylostoma* (op. cit., II, p. 350): "Les variees ou impressions du labre ne sont certes pas un caractère important; mais ce qui l'est davantage, c'est la constance de la forme de la bouche, rappelant celle des Natices, mais en étant bien plus étroite et plus modifiée par l'avant-dernier tour." Again, of *T. fallax* the same authors write (op. cit., II, p. 351): "On ne voit sur le moule de l'adulte que des traces bien douteuses ou effacées des bouches successives; mais si, comme nous le pensons, on doit rapporter à la même espèce des moules plus petits qui ont exactement les mêmes proportions, nous pouvons ajouter que dans les jeunes les impressions sont visibles et profondes deux fois par tour."

Conrad noted the resemblance of his *Chenopis Syriacus* to *Natica prolunga* Desh. (Leymerie, 1840, Mém. Soc. Géol. de France, (1,) IV, p. 342; Leymerie, 1842, Ibid., (1,) V, p. 13, Pl. xvi, fig. 8; d'Orb., 1842, Paléont. Franç., Terr. Crét., II, p. 152, Pl. clxxii, fig. 1; d'Orb., 1842, Voy. Amer. Mérid., III, Pt. 2, Paléont., p. 78, Pl. xviii, fig. 1); and it may be insisted by some that his figure corresponds to the figures of that species rather than to those of *elatior* and *fallax*. But if the outlines of the aperture in Conrad's figure be restored, and if his representation of the columellar lip is accurate, his species, as already remarked, must be referred to *Tylostoma*. The resemblance of the three so-called species named above to *Natica prolunga* is very striking.

Say Pietet and Campiche (op. cit., II, p. 352): "Le *T. fallax* est facile à confondre avec le *Natica praelonga* d'Orb., dont il a tout à fait les dimensions, l'angle spiral, etc. Il a été souvent placé sous ce nom dans les collections et probablement cité dans les catalogues. Il est du reste bien distinct, et si les moules ne sont pas énervées, on reconnaît facilement le Tylostoma à son ouverture étroite, bien moins oblique, aigu en arrière, et à son bord columellaire presque droit."

Though *N. praelonga* is still recognized as a distinct species by the Swiss palaeontologists just quoted, and by Coquand, who claims to have found in Algeria both that and his species *claviger*, it would not be surprising if the study of fuller suites of all the above named (hitherto known only from easts), together with the careful observation of their variations and distortions, should lead to their reduction to a single species.

Coll. Merrill, Thomson, and Congregational House.

Locality and Position. — Beirût district; from a yellow ferruginous marl, probably identical with that of Abeih.

? **Tylostoma depressum** PICTET and CAMPICHE.

Plate I, fig. 7.

Tylostoma depressum PICTET and CAMPICHE, 1862, Foss. du Terr. Crét. de Ste.-Croix, II, p. 355,
Pl. lxxiii, figs. 10, 11.

Single internal cast, incomplete at apex, four whorls remaining. Length, 63 mm., originally about 70 mm.; width, 53 mm.

This seems to be an adult specimen of the Swiss species named above, of which Pietet and Campiche figure two casts of immature individuals, bearing impressions of the internal varices. They represent *T. depressum* as being distinguished "par ses proportions et par la forme de son dernier tour, qui est court, déprimé à sa partie antérieure, ce qui rend la bouche courte, obtuse et oblique." (loc. cit.) This description applies without qualification to the Lebanon fossil.

Coll. Congregational House.

Locality and Position. — Probably the Beirût district; from a yellow marl, apparently identical with that of Abeih.

Tylostoma induratum CONRAD sp.

Plate I, figs. 8 a, b.

Chenopus induratus CONRAD, 1852, Official Report, p. 220, Pl. xi, fig. 69.

Two internal casts. Dimensions of largest: length, shortened at each extremity, 53 mm.; original length, approximate, 60 mm.; width, a little compressed, 37 mm.

In size, proportions, shape of aperture, and columellar lip, these casts correspond to Conrad's figure and description; but their characters indicate that they belong to a species of *Tylostoma* closely related to (possibly identical with) *T. Torrubiae* Sharpe (Quart. Jour. Geol. Sci., London, V. p. 378, Pl. ix, figs. 1, 2). Of such casts the specific descriptions must be necessarily imperfect. Lartet observes (Expl. Géol. de la Mer Morte, p. 120), "Le moule que M. Conrad figure sous ce nom [*Chenopus induratus*] pourrait bien se rapporter à un autre genre." Coll. Merrill.

Locality and Position. — Beirut district; from a yellow marl, apparently identical with that of Abeih.

Turritella elæonis, sp. nov.

Plate II, figs. 1 a, b.

Testa parva, tenuissima, pyramidali-turrata: anfractus octoni seu noveni, ad suturam valde constricti, lineis incrementi insinuatis striati, medio unicarinati, a carina utrinque ad suturam piano-declives: carina angusta, in anfractibus summis elevata, acutiuscula: basis truncata, ad peripheriam carinata et acute angulata, inferne planata: superficies anfractuum infra carinam filo uno tenu, supra duobus tenuissimis parallelis cincta: apertura transversim et anguste orata.

Shell small, exceedingly thin, pyramidal turreted: whorls eight or nine, strongly contracted at the suture, striated with sinuous lines of growth, in the middle one-keeled, from the keel sloping in both directions to the suture: keel narrow, on the upper whorls elevated and rather sharp: base truncate, flattened below, keeled and acutely angled at the periphery: surface of the whorls below the median keel encircled with a single delicate thread, and above the keel with two still more slender and parallel ones: aperture transversely and narrowly ovate.

Two specimens. One retains the test and six entire whorls, with part of

a seventh above. Length, 20 mm.; when complete, about 22 mm.; width, increased by pressure, 8 mm. The other is an internal cast, with five entire whorls and parts of others.

The most remarkable character of this species is to be found in the flatly truncate base, making nearly a right angle with the axis of the shell (as in a few recent species), and bearing at its periphery a sharp keel, which on each preceding whorl is covered by the growth of the following volution. The aperture is incomplete, transverse, and narrowly oval (perhaps through pressure), and the columellar lip is turned very abruptly outward from the flat base. Some whorls of the cast show a single delicate raised line half-way between the median keel and the suture below, while midway from the keel to the suture above run two parallel fainter threads. These threads can hardly be distinguished, except with a lens, and on the specimen retaining the test are obscured by the lines of growth, which by their deep curve prove that the lip was strongly insinuate at the middle. The lines of growth are heaviest upon the flat base. Coll. Bird.

Locality and Position. — Mount of Olives. If Fraas is correct in regarding the fossils on the whole line from Jaffa to the Dead Sea as belonging to the Upper Cretaceous (Turonian and Senonian), this species is probably from that horizon.

Turritella sp.?

Plate II, figs. 2 a, b.

Fourteen casts incomplete. Coll. Thomson.

Locality and Position. — Probably Beirut district and from the Turonian Gasteropod zone.

Scalaria sp.?

Plate II, figs. 3 a, b.

Three internal casts, incomplete and somewhat flattened by pressure.

Largest, having four whorls, length, 49 mm.; width, increased by flattening, 25 mm. Fragment having two whorls and part of a third, length, 34 mm.; width, flattened, 24 mm.

Distinct traces of longitudinal ribs upon one of the casts indicate that the specimens belong to *Scalaria* rather than *Turritella*. The well-known *S. Dupiniiana* d'Orb., from Campiche's Sainte-Croix collection, in the Museum

of Comparative Zoölogy, also shows upon casts the remains of longitudinal ribs, and considerably resembles these specimens.

As the *Scatariidae* are only doubtfully represented in the Jurassic formation, these casts go to confirm the view that the beds from which they were taken are not older than the Cretaceous period. Coll. Merrill.

Locality and Position.—Beirút district; from the arenaceous marl, probably Turonian.

Eunema? bicarinata, sp. nov.

Plate II, figs. 5 a, b.

[*Turbo* auct.; *Amberleya* MORRIS & LYCETT, 1850, but inadequately defined, Moll. from Gr. Ool., Pt. I, p. 54; *Eunema* SALTER, 1859, Canad. Organ. Remains, Dec. 1, pp. 24 and 29, Pl. vi, fig. 4; *Eucyclas* EUDÉS-DESLONGCHAMPS, 1860, Mém. Soc. Linn. de Normandie, V, p. 138.]

Testa turbinato-conica, tenuiscula, hanc umbilicata: anfractus quinque vel sex, carinis duabus, superiori juxta suturam, secunda maiore supra medianu posita, minuti; ultimus intra carinas alle concavus, infra liris tribus cinctus: apertura superne canaliculata, inferne rotundata; labium exsertum a pariete distinctum.

Shell turbinate-conic, rather thin, without umbilicus: whorls five or six, strengthened by two keels, the upper placed near the suture, the second and larger below the other, but above the middle of each volution; the last whorl deeply concave between the keels and below them encircled by three ridges: aperture channelled behind, round in front; inner lip considerably projecting and separate from the body-wall.

Single specimen, almost entire. Length, 33 mm.; width, 23 mm.

The test of the specimen figured is too badly weathered to show, had they once existed, the "strongly sinuate, prominent, and threadlike lines of growth" (Salter, op. cit., p. 24) which mark the typical species. In other respects the shell agrees with the diagnosis of the genus as given by Salter and Morris and Lyett. One character noted by the last-named authors is very conspicuous in this example, viz.: "The whorls are received into the concavity of those which succeed, the latter at their junctions being slightly overwrapped by the former." (loc. cit.) In this instance the ridge next below the greater keel seems to overlap and nearly hide the suture just beneath. Our shell strongly resembles Salter's typical species, *strigillata*, in its sharp and prominent revolving ridges, posterior canal, and inner lip "not reflected or pressed closely against the columellar base." (Salter, op. cit., p. 29.) Fig. 5 a shows within the aperture a deposit which, were

it not for the distinct posterior canal, might be considered a layer of the shell inside the outer, such as occurs most conspicuously in *Monodelph. labio* Linn., and some species of *Osilius*. On careful examination, this seems to be no part of the original shell.

The genus *Emema*, to which I am inclined to refer this species, — though not without hesitation, — is reported as ranging from the Silurian to the Cretaceous formation. Zittel, in his recent *Handbuch der Palaeontologie*, I. Band, 2. Abtheilung, p. 189, 1882, assigns it to the subfamily *Turbininae*. Salter, Morris and Lyett, and Stoliczka concur in regarding it as belonging to the *Littorinidae*. In the specimen before us, the mode in which the last whorl receives the preceding one finds no counterpart in any member of the *Turbininae*, while the general resemblance to *Tectarius*, and especially the likeness in the junction of the volutions and in the spiral ridges (not in the aperture) to the recent Australian *Osilius constrictus* Macleay, forcibly suggest the relation of the fossil to the *Littorinidae*. Coll. Bird.

Locality and Position. — Abeih ; from the Turonian yellow marl.

Nerinea pauxilla, sp. nov.

Plate II, fig. 4.

Testa parva, acuminato-turrata; spira angustus 27°, suture 93°; anfractus circiter duodecim, medio profunde excavati et striis volventibus minimis notati; margines elevati et minute crenulati, posterior fortior: apertura subquadrata, canaliculata; columella biplicata, imperforata; tubri notae incognita; canalis brevis ut nihil videtur recurvus.

Shell small, acuminate turreted ; angle of spire 27°, of suture 93°; whorls twelve or more, deeply excavated in the middle and marked with very small encircling lines ; margins elevated and minutely crenulated, the hinder being larger than the anterior : aperture subquadrate, canaliculate ; columella with two folds, imperforate ; characters of outer lip unknown ; canal short and apparently recurved.

Single specimen, adhering to a mass made up chiefly of broken shells, and strongly ferruginous. Length, 16 mm. ; width, 6 mm.

Of the many other species described, none correspond very nearly to this. The Jurassic *N. carellia* d'Orb. — much larger — is perhaps most like it in superficial markings. As in some other species of the same genus, the upper margin of each whorl is larger, more prominent, and more crenulated than

the adjacent lower margin of the preceding whorl; while in *Turritella* the lower margin is larger and often rougher than the upper, known as the sutural band, which is usually rather smooth. Weathered, adherent, and with the outer lip broken away, as is the single specimen, its specific description cannot be very full or exact. Coll. Merrill.

Locality and Position.—Mountains of Gilead. To the same fragmental mass with this a specimen of *Rostellaria Rustemi* Fraas is attached, of which Fraas had his examples from the Gasteropod zone at Abeih. Our *Nerinea* must therefore be referred to the same subdivision of the Turonian.

Nerinea gemmifera COQUAND.

Nerinea gemmifera COQUAND, 1862, Géol. et Paléont. de Constantine, p. 177, Pl. iv, fig. 4.
" " LARTET, 1875, Expl. Géol. de la Mer Morte, p. 119, Pl. viii, fig. 12.

Fifteen specimens, mainly incomplete casts, but in several instances retaining the test. All are completely silicified, and the greater number are tinged reddish or yellowish by oxide of iron. Coll. Thomson.

Coquand instituted the species from examples discovered in Algeria, but afterward met with it in the department of Var, S. E. France. He assigned it to *l'élage provençal*, the upper member of the Middle Cretaceous in the classification which he adopts. Lartet recognized the species at "Jebel el Museikah, near Kurnub, in the southern part of the Judean range." Fraas makes no mention of it.

Locality and Position.—Probably from the vicinity of Abeih. The only fossils in the different collections with which these coincide in character of mineralization are the specimens of *Cerithium gracilens nobis* (see p. 36), from the splintery limestone of the Gasteropod zone of Abeih. The present species may therefore be regarded as in all probability belonging to that stage of the Turonian.

Nerinea (Cryptoplocus) Libanensis, sp. nov.

Plate II, figs. 8 a, b.

[*Cryptoplocus* PIETET and CAMPICHE, 1862 (Foss. du Terr. Crét. de Ste.-Croix, II, p. 257.)]

Testa turbinato-conica, longior quam latior, late umbilicata : spiræ angulus 32° : anfractus circiter septem sive octo, complanati, transverse sulcati, superne ad suturam rictati, ultimus infra angulum : apertura subquadra. Ceteræ notæ desunt.

Shell turbinate-conical, longer than broad, widely umbilicated; angle of spire 32° : whorls about seven or eight, flattened, transversely sulcate, banded above at the suture, the last angled below: aperture subquadrate. The other characteristic marks are unknown by reason of imperfection of the specimen.

Single specimen, a fragment retaining the test. Length, 37 mm.; when entire, about 50 mm.; width, 28 mm.

In respect to size, general proportions, and the sutural band, this shell is very similar to *Cryptoplocus cingulatus* Zittel, 1873 (Gastrop. der Stramb. Schichten, p. 261, Pl. xlvi, fig. 20), which, however, from the basal angle upwards is girt with granular ridges. In this specimen, although the test is so much decayed that the original character of its surface is obscured, it can be seen that each whorl was marked with a few distant encircling furrows, but the nature of the intervening ridges is uncertain. The last volution, near the mouth, has been thrust inward enough to compress the aperture somewhat, and to encroach upon the umbilicus, which originally must have been wide and circular. The aperture shows the absence from the labrum and columella of the folds which characterize *Nerinea* proper, but is so closed by stony deposit that it is impossible to determine whether the single concealed fold upon the hinder part of the inner lip, peculiar to *Cryptoplocus*, is present or wanting. Yet the wide and round umbilicus, the quadrate mouth without canal, and their relations to each other, sufficiently distinguish this species from *Turritella*, *Cerithium*, and *Trochus*, the only genera with which it could be confounded.

The resemblance of this fossil to several varieties of *Nerinea pyramidalis* Münster, to *N. depressa* Voltz (*N. umbilicata* Voltz) and *Trochus monoplacis* d'Orb., all of which are now recognized as species of *Cryptoplocus*, tend to support our view of its generic relations.

Pietet and Campiche classified *Cryptoplocus* as a genus distinct from *Nerinea*, while Zittel (Gastrop. der Stramb. Schichten, p. 257, 1873, and Handb. der Palaeont., I. Band, 2. Abtheilung, p. 247, 1882) regards it as a subgenus of *Nerinea*. Coll. Merrill.

Locality and Position.—Beirut district; from an arenaceous marl, probably Turonian.

Alaria monodactyla, sp. nov.

Plate II, figs. 6 a, b, c.

[*Alaria* MORRIS & LYCETT, 1850, as restricted by Gabb, 1869, Am. Jour. Conch., V, p. 21, and adopted by Zittel, 1882, Handbuch der Palaeontologie, I. Band, 2. Abtheilung, p. 252.]

Testa turrata, fusiformis, alata, caudata: anfractus septeni vel octoni, sutura profunda sejuncti, costis seu varicibus rotundatis exstantibus pterumque continuis armati, filis tenuibus transversis undique ornati; ultimus unicarinatus, penultimi costae seu varices septem aquales, ultimi incomposite et partim obsoleta: apertura trigona; canda recta plana; ala in digitum rectum brevem evadens; labrum tenue, angustum.

Shell turreted, fusiform, winged and produced into an anterior canal: whorls seven or eight, separated by a very deep suture; armed with rounded projecting longitudinal ribs or varices, generally continuous from whorl to whorl; everywhere ornamented with thin transverse threads which cross the ribs; the last whorl bearing a single keel, the next to the last having seven equal ribs or varices, which on the last become unequal, irregular, and in part obsolete: aperture triangular; canal straight, flat; wing terminating in one short and straight digitation. Inner lip thin and narrow.

Four specimens. Of the best preserved, length, 17 mm., when complete, about 19 mm.; width of body-whorl, without digitation, 8 mm. Of largest, length, 20 mm., originally, about 25 mm.; width of body-whorl, without digitation, 9 mm.

On the last whorl at the distance of half a revolution from the outer lip is a well-marked, Ranella-like varix, which with those of the preceding volutions forms a longitudinal row continuous to the apex; and upon all the whorls, except the last, the ribs or varices are generally arranged in straight unbroken lines, but sometimes irregularly. Two obscure transverse ridges cross the shell where it begins to narrow into the canal. Coll. Bird.

Locality and Position. — Abeih; from the Turonian arenaceous marl.

Rostellaria Rustemi FRAAS.

Rostellaria Rustemi FRAAS, 1878, Aus dem Orient, II. Theil, p. 67, Pl. vi, fig. 4.

Single specimen adherent to a lump made up of broken and comminuted shells, and side by side with *Nerinea pavilla* nobis (see p. 25). Length, when entire, about 28 mm.; width, wing wanting, 13 mm.

In neither this nor Fraas's specimen is the wing preserved. Coll. Merrill.

Locality and Position.—Mountains of Gilead. Found also at Abeih and referred by Fraas to his Turonian Gasteropod zone.

Pterocera (Harpagodes) sp.?

Plate II, fig. 7.

A single internal cast, on the back distorted by pressure, and on the right side somewhat broken away. Under surface normal. Length, 109 mm.; width, 75 mm.; height, 65 mm. Of a specimen of *P. Jeannensis*, which retains the test nearly entire, except the digitations and part of the spire, the dimensions, as given, are, length, 118 mm.; width, 93 mm.

Of the larger fossil *Pterocerae* which have been figured and described, this cast has little resemblance to any but the Cretaceous *P. pelagi* Brongn., and the Jurassie *P. Jeannensis* Cotteau. Careful comparison with the excellent original figures of the former (Ann. des Mines, (1.) VI, p. 554, Pl. vii, fig. 1 *a, b, c*), and with well-preserved specimens of the same, in the Campiche collection of the Museum of Comparative Zoölogy, from Sainte-Croix, Switzerland, as well as with the numerous figures of *P. Jeannensis*, supplied by the continuation of the Paléontologie Française (Terr. Jurass., III, Pl. xlvi-xxviii, lxxvii, lxxx-lxxxiii), inclines us to believe that the cast belongs to neither species. But the exceptional difficulty which the genus *Pterocera* presents for the determination of fossil species, arising from the rarity of complete examples and their very considerable variations, renders it unsafe to found a new species upon the interesting but distorted cast before us. The aperture seems to have been proportionally narrower than in other large species of the genus. Coll. Congregational House, Boston.

Locality and Position.—Probably the Beirût district; from a yellow marl similar to the beds at Abeih.

Actæonina vafra, sp. nov.

Plate III, figs. I a, b.

Testa ovato-cylindracea, obscure rimato-perforata: spira productuscula, apice aenato: anfractus circiter sex, plano-convergi, ultimus per amplius spiræ longitudinem triplo superans; sutura impressa: superficies striis incrementi non unquam fortioribus notata: apertura elongata, postice acuminata, antice latior ac rotundata; labium

prope rectum, reflexum, edentulum, ad marginem anteriorem effusum et incrassatum, postice tenuissimum; labrum tenui.

Shell ovately cylindrical, apparently rimate perforate: spire rather produced and with an acute apex: whorls about six, flatly convex; the body-whorl very large and three times as long as the spire; suture impressed: surface marked with striae of growth, of which some are quite heavy: aperture elongate, narrowed to a sharp termination behind, in front rather wide and rounded; inner lip nearly straight, spread upon the body wall, without folds, at the front effuse and thickened, while posteriorly it is very thin; labrum thin.

Single specimen, with test. Length, $35\frac{1}{2}$ mm.; width, $18\frac{1}{2}$ mm.

The combination of characters indicates this to be a genuine *Acteonina*; viz. the relative proportions of the spire and body-whorl; the inner lip, before flatly thickened at the edge and neither plicated nor twisted; the aperture evenly rounded in front and sharply angled behind; the last whorl anteriorly somewhat suddenly contracted. Yet the inner lip, conspicuously spread upon the body-whorl through the whole length of the aperture, and the apparent rimate perforation of the columella, distinguish this from any other species of the genus which has been hitherto figured. The seeming, and probably real, perforation is the continuation of a pit formed by an unusual projection of the thickened edge of the inner lip over the concave part of the narrowed front of the body-whorl. It resembles the rimate umbilicus of some species of *Bulimus*.

In the published figures of *Acteonina olivaformis* Koch and Dunker, the species most like this, good front views are wanting, perhaps from imperfection of the specimens delineated. The back of *olivaformis*, as figured by Morris and Lyett (Moll. Gr. Oöl., Pl. xli, figs. 4, 4 a), sufficiently resembles that of our specimen to allow the two to be regarded as specifically identical. But Morris and Lyett's figure of the front (*Ibid.*, Pl. viii, fig. 14), and Koch and Dunker's figures of both back and front (*Norddeutschen Oolithgebildes*, Pl. v, figs. 3 a, b), do not agree with the Lebanon fossil. Moreover, no adequate description of *olivaformis* exists, since the original one by Koch and Dunker (*Ibid.*, p. 41, 1837) is brief and meagre, while Morris and Lyett (*op. cit.*, Pt. I, p. 103) have simply copied it without additions. It has therefore seemed best, provisionally at least, to describe the Lebanon shell as a new species. Coll. Bird.

Locality and Position. — Abeih; from the more arenaceous portion of the Turonian yellow marl.

Colostracon, gen. nov.

(κάλος, decurtatus; ὄστρακον, testa.)

Testa inverso-conica aut decurtato-fusiformis, tenuis; spira valde depressa, plana aut immersa: infractus quaderni quini vel sei, conformatim convoluti, a lateribus planati et plus minusve insinuati, postice truncauti aculeo angulati et ad angulum aliquanto carinati, sutura perspicua dicisa; ultimus antice si non in canaliculum at in rostrum tamen porrectus: superficies lineis incrementi rotata et per partes spiratiter striata aut leviter sulcata: apertura reclusula, contracta, teste longitudini adarqueans, ante medium dilatata, antice angustata; columella arcuata, edentula, prolongata et paudem contorta, labio tenui reflexo modice obiecta, perunguis rimulata; labrum simple.

Shell inversely conical or decurate-fusiform, thin; spire greatly depressed, plane or immersed: whorls four to six, compactly convolute, laterally flattened and more or less insinuate, behind truncate, acutely angulate and at the angle considerably keeled, separated by a distinct suture; the body-whorl produced in front into what must be styled at least a beak, if not a proper canal: surface marked with lines of growth and on portions spirally striated or lightly grooved: aperture rather straight, contracted, as long as the entire shell, widened before the medial line, narrowed in front; columella arcuate, without folds, prolonged and somewhat twisted, moderately covered by the thin reflexed labium, very narrowly fissured; labrum simple.

Absence of folds from the columella and the presence of transverse striations upon their exterior exclude these shells from *Cylindrites*, but suggest their classification under *Aetacina*. To the latter genus they would certainly seem to belong, were it not that a short but distinct anterior beak or canal is present in our typical species. And though from imperfection of the specimens it cannot positively be asserted that a similar beak occurs in the second species described by us, nor in that resfigured from Fraas, the combination in both of like peculiar and striking characters leads to the inference from analogy that the *beak* can hardly be wanting in perfect examples.

Of the species of *Aetacina* known to us from actual specimens, not one shows any indication of a beaked or channelled aperture. Loriol's figure of his *A. Davidoni*, étage portlandien (Monogr. des Étages supérieurs de la Formation Jurassique de Boulogne-sur-Mer, p. 44, Pl. vi, figs. 8, 9, 1873),

shows a *semblance* of a beak. So, too, in the original figures of *A. brevis** Morris and Lycett (Moll. Gr. Oöl., Pt. I, p. 101, Pl. viii, figs. 13, 13 *a, b*, 1850,—there named *Cylindrites brevis*) appears what might be mistaken for an anterior canal. In the latter case, however, the figures are side views, and give a false impression of the anterior of the shell; for a front view of the specimen afterwards figured in the Supplement of the same work (Pl. xli, fig. 6, 1863), exhibits the “aperture evenly rounded in front,” which by all authorities is regarded as a constant character of the genus. The original of this figure (from the Great Oölite of Kirtlington, near Woodstock, Oxfordshire), the only adult specimen known up to the date of Morris and Lycett’s Supplement, has been kindly lent to us by the collector, Mr. J. F. Whiteaves, Palaeontologist of the Canadian Geological Survey. Of all *Aetrominae*, this species has the closest general resemblance to the species of the group here considered. Like them it is posteriorly truncate, and has its sides flattened; but its aperture, the lifting of part of the last whorl above the plane of the spire, the rounding of the margins of the truncate convolute whorls, and the smooth surface, as seen in Pl. iii, figs. 2 *a, b, c* (drawn anew for this paper from the specimen itself), are in strong contrast with the corresponding parts of *Colostracum*.

Without wishing to lay special stress upon the form of the spire, one of the most variable of characters,† we may yet note that forms like *A. concava*,‡ *A. subabbreviata*, *A. Cumnortii*, d’Orb., and the various species of *Ilieria*,—with which the Abeih species will most naturally be compared,—present posterior extremities (vertices) very unlike those of the latter. In fact, the only known shell which exhibits a vertex as cleanly cut as theirs, is *Raphistoma striatum* (Emmons) Hall, the subtrigonal aperture and deep open umbilicus of which remove it far from *Colostracum*.

In *Cylindrites cylindricus* Morris and Lycett (op. cit., Pt. I, Pl. viii, figs. 19 *a, b, c*), the cylindrical form and the truncate and acutely margined vertex make the nearest approach to the Abeih species. But the vertex is considerably concave, and of the imperfect anterior part (base) only side

* Is this not identical with *Orthostoma conulus* BUVIGNIER, Statistique Géologique et Paléontologique du Département de la Meuse, p. 32, Pl. xxiv, figs. 16, 17, 1852?

† We are well aware that a continuous series of *Aetrominae* may be traced from forms which have the spire plane, or even a little immersed, to those which have the same slightly or even strongly elevated.

‡ Formerly regarded as a fossil *Coneus*. See the original “Mémoire sur les Coquilles fossiles des Terrains secondaires du Calvados, par Eudes-Deslongchamps,” Mém. de la Société Linuéenne de Normandie, VII, pp. 139–150, 1839–42.

views are given, which leave the character of that part doubtful. No folds are represented upon the columella, and if better preserved specimens should show the base to be rostrate, the sum of characters would obviously require that the species should be assigned to our proposed group.

The comments of Meek * and others, based chiefly on imperfect figures, have been charged with adding to the confusion which already existed in the family *Acteonidae*; and there seems to be no hope of bringing order out of that confusion, except by the critical study of its representatives from fuller series than are to be found in American collections. It is only from inability to classify our specimens under any of the recognized subdivisions of this unsettled family, that we have ventured to propose in it a new group. We regret the necessity of drawing conclusions from material so scanty.

Colostracon sinuatum, sp. nov.

Plate III. figs. 3 a, b, c.

Testa tenuissima, decurtato-fusiformis, a latere transversim late insinuata; spira maxime depressa, ab apice aequaliter sed minime ad peripheriam declivis; aufractus circiter sex, postice truncati et angustati, ad angulum acute carinati, sutura linearis perspicua sejuncti; ultimus in rostrum breve productus: superficies lineis incrementi fortioribus flexuosis signata, et ante sinum lateralem sutulis exquis ciueta: apertura anomala, ad sinum angustata; labium tenui, super columellam expansum, antice interrassatum; columella parum contorta, rimulum umbilicarem exhibens.

Shell very thin, decurtate-fusiform, upon the hinder part of the side transversely widely insinuate: spire exceedingly depressed, regularly but very slightly sloping from apex to circumference; whorls about six, truncate and sharply angled behind, acutely keeled at the angle, divided by a distinct linear suture; body-whorl produced in front into a short beak: surface stamped with rather strong flexuous lines of growth, and before the lateral sinus encircled by small shallow grooves: aperture of peculiar shape, narrowed at the sinus; inner lip thin, thickened in front, outspread upon the columella, which is somewhat twisted and shows a slight umbilical chink.

A single specimen, with test nearly complete. Length, 18 mm.; width, at keel, 10 mm.

Figure 3 c represents upon the flat posterior side of the aperture succes-

* Remarks on the Family *Acteonidae*, with Descriptions of some new Genera and Subgenera. Am. Jour. Science, (2,) XXXV, pp. 84-94, 1863.

sive bent raised lines, which indicate in the progressive growth of the shell the presence of a shallow notch at the edge of the aperture, corresponding on a small scale with the fissure of *Pleurotomaria*. These markings are very like those which have given name to the palaeozoic genus *Raphistoma* Hall (Palaeontology of New York, I, p. 28, 1847). Coll. Bird.

Locality and Position.—Abeih; from an arenaceous portion of the Turoanian yellow marl.

Colostracon curtum, sp. nov.

Plate III, figs. 4 a, b, c, d.

Testa inverso-conica, longior quam latior, spira sere plana, ab anfractus ultimi parte interiori usque ad centrum minime concavus; anfractus quatuor vel quinque centrum versus amplitudine citius decrecentes; ultimæ lateribus planis ante angulum parum constrictis: apertura recta, angustiuscula, antice latior: superficies postice striis minutis fluctuosis, antice sulcis exiguis cincta; labrum simplex, tenuissimum; labium anguste ac tenuiter reflexum; columella leviter rotundata.

Shell inversely conical, longer than wide, spire almost plane, very slightly concave from the inner side of the last volution to the centre: whorls four or five, rather rapidly diminishing in thickness towards the centre, having the sides flat and very slightly constricted just before the angle: aperture straight, rather narrow, wider in front: surface encircled behind with minute wavy striae, before with light grooves; outer lip simple, very thin; inner lip narrowly and thinly spread upon the columnella, which is slightly fissured.

Single specimen. Length, 17 mm., originally about 20 mm.; width 12 mm.

In the specimen from which the foregoing description is drawn, the surface is spirally marked behind with minute wavy striae, and in front by rather wide shallow grooves. Between the two extremities the shell is corroded, but shows traces of lines intermediate in character between those of the anterior and posterior parts, indicating that the whole exterior was originally covered with revolving lines which became anteriorly wider and deeper. It seems probable that in its perfect state the front was produced into an Io-like beak, as in the last species. Coll. Bird.

Locality and Position.—Abeih; from an arenaceous portion of the Turoanian yellow marl.

Colostracon Lewisii FRAAS sp.

Plate III, figs. 5 a, b.

Globiconcha Lewisii FRAAS, 1878, Aus dem Orient, II. Theil, p. 65, Pl. vi, figs. 5 a, b.

This species clearly belongs to the same genus as the last two, presenting the strong generic characters of the group, yet with differences which separate it specifically from the others. Fraas terms it a *Globiconcha*; but if that genus can be said to have been intelligibly characterized, which is at least doubtful,* this surely is not a species of the genus.

Having never seen the fossil itself, we copy Fraas's figures and his very brief description of the species, which is as follows: "Eine Muschel von 23 mm. Länge mit zarten Längsstreifen und noch zarteren Querstreifen versehen und einem inneren Canal. Die Windungen, 3-4 an der Zahl, sind vertieft und nabelförmig eingedrückt, wodurch die Muschel ein höchst eigenthümliches Aussehen gewinnt." (loc. cit.)

Locality and Position. — Abeih; from the Turonian Gasteropod zone.

Melo pervetus CONRAD sp.

Plate III, fig. 6.

Strombus pervetus CONRAD, 1852, Official Report, p. 221, Pl. xiii, fig. 73.

Single specimen, an interior cast, imperfect, but exhibiting very nearly the original outlines. Length, not much abridged, 103 mm.; width, somewhat increased by depression, 63 mm.

Though this is much smaller than the specimen figured by Conrad, precisely the same proportions of spire and body whorl, and the same sutural angle, appearing in both, their specific identity seems altogether probable.

* Stoliezka remarks (Cretaceous Gastropoda of Southern India, p. 410): "When lately at Paris I endeavored to find out from d'Orbigny's collection in the Jardin des Plantes the real signification of the name *Globiconcha*, but I turned away disappointed, not being able to arrive at any reasonable conclusion. Not one of the specimens named by d'Orbigny is a perfect shell, but all imperfect casts, which can be variously commented upon. Some of them have been shown to belong to *Cypraea*; others appeared to me to represent casts of *Tylostoma*, *Natica*, and probably of *Cinula*. There have been, however, by subsequent authors, various globular shells described under the name of *Globiconcha*, and of these some very much resemble *Bulliaula* and *Hydatina*."

Zittel (Handbuch der Palaeontologie, I. Band, 2. Abtheilung, p. 296) records the genus under the family *Bullidae*, in this doubting style: "? *Globiconcha* d'Orb. Auf unbestimmbare Steinkerne von ansehnlicher Grösse aus Kreideablagerungen basirt, welche wahrscheinlich zu verschiedenen Gattungen gehören."

On applying to Conrad's figure a recent *Melo Aethiopica* of corresponding size, such coincidence of outlines appears as convinces the observer that the two are generically equivalent.

Fossil species of *Melo* are rare, but are found in the Cretaceous and Tertiary formations. Stoliezka describes a single species, *M. pyriformis* (Cretaceous Gastropoda of Southern India, p. 83, Pl. vi, fig. 9) from India.

Lartet (Expl. Géol. de la Mer Morte, p. 115), under the heading *Strombus peretus*, speaks as follows: "Nous avons trouvé au waddy Heïdan un moule de Gastéropode qui se rapproche de cette forme et ressemble ainsi au *Pterocera inornata*." Our specimen and that figured by Conrad, on comparison, will be found *very unlike* *P. inornata* d'Orb. (Paléont. Franç., Terr. Crét., II, Pl. cexiv). Coll. Merrill.

Locality and Position.—Beirût district; from a yellow marl, probably Turonian.

Cerithium gracilens, sp. nov.

Testa elongata, turrata, spiræ angulus 14°–16°, suturæ 87°: anfractus multi-complanati, paucum excavati, sutura profunda sejuncti, termis scribns tuberculorum ornati: tuberculis in serie mediana celeris multo minoribus: basis anfractus ultimi subconvergat, moderate producata, spiralliter serie una tuberculata; apertura quadraangularis, ante canali angusto terminans.



An elongated turreted shell composed of numerous flattened volutions, which increase very gradually in length and width. Each of the whorls is ornamented with two rows of rounded and close-set tubercles, adjacent to the suture, which are so prominent as to give to the volutions the appearance of being somewhat excavated. Midway between these rows is a third, made up of much smaller tubercles, less prominent and distinct.

Nineteen specimens, none entire, but the greater number retaining the test.

It may have been such specimens as these, found at Abeih, which Fraas considered to be *C. trimonile* Michelin* (Aus dem Orient, II. Theil, p. 70). That species is very extensively distributed, for besides being known in the Gault of France, it has been recognized by Stoliezka in Southern India. On comparison with Michelin's, d'Orbigny's, and Stoliezka's figures of *C. trimonile*,

* Mém. Soc. Géol., III, p. 100, Pl. xii, fig. 5, 1838.

I am satisfied that the Lebanon specimens before me belong to a species distinct from that. In the first place, they are proportionally longer and narrower than Michelin's species, which has a spiral angle as great as 30° and 32° ; while the spiral angle of the shells in hand is never larger than 16° . Again, according to the best description of *trimouile*, that of Stoliezka, the tubercles of the uppermost or posterior row in young specimens are always distinctly divided by a deep groove, while the tubercles in the other two rows approach so near each other that they seem to form short transverse ribs. The anterior row has generally the largest tubercles; but sometimes the tubercles of the two anterior rows are nearly equal, and not so strong as those of the posterior row. Besides the tuberculated ridges, the entire shell-surface is minutely striated. None of the foregoing specifications of Stoliezka's apply to the present species. The younger specimens have the tubercles of the anterior and posterior rows equal in size; but in some of the older, the tubercles of the posterior row become the larger. Nor are the tubercles of either row divided by a groove. The central row always consists of smaller tubercles, much less prominent and distinct than those of the other rows. On the base of the last or anterior whorl is a single row of indistinct tubercles parallel to the other rows. Old specimens show heavy lines of growth upon the sides and base. Coll. Thomson.

Locality and Position. — Probably Abeih or its vicinity. The specimens of this species, like those of *Nerita gemmifera*, already noticed on page 26, are completely silicified and colored reddish or yellowish by oxide of iron. Fraas represents a splintery limestone bed (*splitterige Kalkbank*) of the Gasteropod zone of Abeih as being most productive of *Cerithia*. Since in limestones the mineralizing factor of fossils is more commonly silex, it is highly probable that these specimens were taken from the limestone layer of the Turonian Gasteropod zone.

UNDETERMINED.

Six casts from the Merrill collection, of which the two in best condition are represented on Plate II by figures 9 *a, b*. They seem to be identical with the specimen described and figured by Conrad (Official Report, p. 234, App., Pl. v, fig. 43) as *Cancellaria petrosa*. The casts have a few distant and rather oblique longitudinal ribs, but I find no proof that they belong to the genus *Cancellaria*.

LAMELLIBRANCHIATA.

Corbula algera, sp. nov.

Plate IV, figs. 6 a, b, c, d.

Tesla parra, triquetra, inaequilateralis, clausa; valvula dextra paulo major quam sinistra; postice acuminata, valde angulata; margo anticus insinuatus et infra rotundatus: umbones antemediani, superne appressi et obtusi, involuti, antorsum intorti: superficies rugis sive varicibus concentricis irregularibus crassis induita: lunula infra illimitata; area cardinalis perangusta, lanceolata, tenuiter excavata. Carina acuta alata, ab umbonibus ad terminacionem postero-inferiorum recte decurrentis, arcum posse tam subconcavam costulis radianibus instruetam a lateribus dividit.

Shell small, triangular, inequilateral, perfectly closed at the margins; right valve a little larger than the left, and tightly overlapping it; posteriorly acuminate, strongly angled; anterior margin situated above and rounded below; umbones a little in front of the middle point of the shell, obtuse above as if pressed downward, involute and bent forward: surface covered with thick, irregular concentric plaits, or varices: lunule undefined below; hinge area very narrow, lanceolate, slightly excavated. A sharp, wing-like keel, running straight from the beaks to the postero-inferior extremity, divides from the lateral surface the subconcave hinder area, which is marked with radial riblets.

Three specimens. Length, $9\frac{1}{2}$ mm. to $10\frac{1}{3}$ mm.; height, 6 mm. to 7 mm.; thickness, inside of keels, 4 mm. to 5 mm.

The concentric plaits are much narrower than the intervals which separate them. They stop short upon the thin and elevated keel, and are wholly distinct from the more numerous radiating riblets which adorn the nearly flat posterior area. In these unusual features, the species approaches *C. Valdensis* Hebert and Renevier "du Terrain Nummulitaire supérieur." (Fossiles du Terrain Nummulitaire supérieur des Environs de Gap, des Diablerets, et de quelques Localités de la Savoie. Grenoble, 1854, p. 50, Pl. i, fig. II.) Coll. Bird.

Locality and Position. — From arenaceous marl, probably Turonian and from the vicinity of Abeih.

Liopistha Libanotica, sp. nov.

Plate VI, figs. 7 a, b, c.

Nucleus ovato-oblongus, aequivalvis, valde inaequilateralis; antice brevior, subventricosus, abrupte declivis ac subrotundatus; depression lunularis magna, profunda, marginibus valvarum exstantibus medio divisa; postice productus, elevatus, compressus, subtruncatus, pavum hians: umbones antemediani, prominentes, lati, tumidi, incurvi, maxime approximati: superficies concentrica tenuiter sulcata: ligamentum exterrimum: caro, linea pallii et impressiones musculares ignotæ.

Cast ovately oblong, equivalve, very inequilateral: before shorter than behind, rather ventricose, abruptly inclined and subrotundate; lunular depression large, deep, divided in the middle by the projecting margins of the valves; behind produced, elevated, compressed, subtruncate, slightly gaping: umbones anterior to the middle of the valves, prominent, broad, swollen, incurved, closely approximate: surface concentrically and lightly sulcate: ligament external: hinge, pallial line, and muscular impressions unknown.

Three specimens, internal casts.

Largest :	length, 102 mm. ; height, 80 mm. ; thickness, 56 mm.
One figured :	" 76 mm. ; " 61 mm. ; " 42 mm.
Smallest :	" 73 mm. ; " 52 mm. ; " 36 mm.

As seen from the side, the form and proportions of the specimens strikingly resemble *Liopistha frequens* Zittel, from the Cretaceous of Gosau (first described by Zittel as *Panopora frequens* *), and *Poromya superba* Stoliczka, which, with the other species assigned by that author to the same genus, are conclusively proved by Meek † to belong, not to *Poromya* of Forbes, but to his own *Liopistha*, — a classification which has been adopted by Zittel.‡ In the dorsal view, the casts are seen to be much less ventricose than *superba*, and somewhat less so than *frequens*; while the three species agree in the character of the lunular and dorsal areas, as do the present species and *frequens* in their compressed posterior extremities. Traces of teeth are absent from the casts. A short and rather wide oval cavity or pit, just behind the beaks, seems adapted to the gaping and "short and erect fulera" (Meek, op. cit.,

* Denkschriften der Kais. Akad., Math. Naturwissenschaft., XXIV, p. 111, Pl. i, figs. 5 a-g, Wien, 1865.

† Inv. Cret. and Tert. Foss. of Upper Missouri Country, p. 229, Washington, 1876.

‡ Handbuch der Palæontologie, I. Band, 2. Abtheilung, p. 131, München, 1881.

p. 229), — in this species probably continued internally, — which supported the external ligament in the typical *Lipistha*. The lunular region is peculiarly and rather deeply excavated, distinctly circumscribed, and divided in the middle by the projecting anterior margins of the valves. The greatest thickness of the casts is below the umbones, on the vertical line which divides the anterior from the second third; and from the thickest portion the casts thin gradually behind and downwards. The very thin shell gaped slightly behind, and still less, or not at all, in front, while it is evident from one of the two casts, which reflect unmistakably the external characters of the thin test, that the valves were concentrically lightly furrowed and ridged, agreeing in this respect with Meek's section *Psilomya*, b.

Courad's brief description of his *Inoceramus Lynchii* (Official Report, p. 218, Pl. viii, fig. 47), so far as it goes, is not inapplicable to these casts, which may be specifically identical with that; but his figures, also taken from a cast, so imperfectly correspond to our specimens, that on the whole we have thought it best to describe and name anew. Their unlikeness to *Inoceramus* is obvious.

Largest from Coll. Cong. House: the others from Coll. Merrill.

Locality and Position. — Beirût district; from yellow calcareous marl, Turonian.

Ceromya sinuata, sp. nov.

Plate VI, figs. 8 a, b, c.

Nucleus inflato-cordatus, triangularis, equivalvis (?): facies anterior lata, truncata, complanato-excavata, a lateribus carina rotundata obscura sejuncta; cariositas lunularis profunda, cordiformis: pars posterior subcompressa, producta, oblique truncata; declivitas cardinalis paululum curvata; margo inferior plus minusve sinuatus; forae ligamenti angusta et elongata: umbones antemediani, antaversi; apices involuti, attenuati, approximati. Impressiones musculares ac palliales non apparent.

Cast swollen-cordate, triangular, equivalve (?): anterior face wide, truncate, flatly excavated, separated from the flanks by an indistinct rounded keel; lunular hollow deep and heart-shaped: hinder portion rather compressed, produced, obliquely truncate; hinge-slope slightly curved; the lower margin more or less sinuate; the ligamental furrow narrow and long: umbones antemesial, turned forward; beaks involute, attenuate, approximate. Muscular and pallial impressions not distinguishable.

Three casts. Dimensions of largest (figs. 8 *a*, *b*): length, 35 mm.; height $32\frac{1}{2}$ mm.; thickness, 28 mm.; — of second cast (fig. 8 *c*): length, $27\frac{1}{2}$ mm.; height, 25 mm.; thickness, 23 mm.

The largest specimen is unsymmetrical, owing partly to distortion through pressure, but perhaps in part to original inequality of the valves. In the other two examples, the beaks, which in this have been forced into contact, are two millimeters asunder. The flattened anterior face answers well to Agassiz's diagnosis of the genus, and to figures of several of his species. The deep dorsal depression between the umbones is analogous to the corresponding part in several recognized species of *Ceromya*. The hinge was undoubtedly edentulous. The three casts bear crowded concentric striae, too indistinct to be well figured, but very perceptible. These and the absence of any traces of muscular and pallial impressions indicate that the test was very thin. Stoliczka identifies a single species of *Ceromya* in the Cretaceous of Southern India.

Conrad's description and figures of *Opis orientalis* (Official Report, p. 231, App., Pl. ii, figs. 10 *a*, *b*) may possibly refer to this species, but are vague and unsatisfactory. Coll. Thomson.

Locality and Position. — Probably from Beirut district, and from the Turonian.

Pholadomya depacta, sp. nov.

Plate VI. figs. 6 a, b.

Nucleus ovato-oblongus, aequivalvis, perinequilateralis, costulis radiatibus angustis circiter quindecim notatus: pars antica brevissima, obtusa, postica dilatata, compressiuscula, oblique truncata ac medio-reriter hians: umbones inflati parne terminales, depresso, inter se alligentes: margo ventralis arenatus, dorsalis oblique retrocurvatus: lunula absens; area cardinalis anguste lanceolata.

Cast ovate-oblong, equivalve, extremely inequilateral, bearing about fifteen narrow ribs radiating from the beaks: anterior portion very short and obtuse; hinder part widened, somewhat compressed, obliquely truncate and at the truncated edge moderately gaping: the inflated umbones almost terminal, depressed, contiguous: ventral margin areuate; dorsal margin slantingly curved backward: lunule wanting: posterior area narrowly lanceolate.

Single specimen, a cast. Length, $48\frac{1}{2}$ mm.; height, 44 mm.; thickness, 26 mm.

The valves at their anterior junction form a projection, which is conspicuous just below the lunular area, but farther down disappears, seemingly in consequence of flattening over a small space through pressure, which gives a somewhat truncate appearance to the front margin. The slight rim of the lanceolate cardinal area has been removed upon the right side. The radiating ribs, though considerably worn, are still plainly visible, but no trace of concentric lines or wrinkles of growth can be distinguished.

The east most nearly resembles *Ph. rostrata* Matheron, as described and figured by Zittel (Die Bivalven der Gosangebilde in den Nordöstlichen Alpen, Denkschriften Kais. Akad., Math. Naturwissensch., XXIV, p. 115, Pl. ii, figs. 2 *a-e*, 1865). It is, however, proportionally higher, is more ventricose, and lacks the *area posticula profunda, angulo clavato circumscripta*, which is very marked in that species. But for the difference in this last respect, I should regard the two as identical, as they indeed may prove to be upon the accumulation of more material.

Comparison with Conrad's type may show this to be his *Ph. decisus* (Official Report, p. 217, Pl. vii, fig. 44), which was described and figured from a single specimen found at Bhamdūn, in the Beirút district. But I am unable to make the two to be one and the same species on the evidence of Conrad's figure and description. Coll. Merrill.

Locality and Position. — Beirút district; from a highly ferruginous Turo-nian deposit.

Cytherea (Callista ?) Libanotica, sp. nov.

Plate IV, figs. 3 a, b, c.

Nucleus orato-triangularis, inaequilateralis, tumidior, antice breviter et late rotundatus, postice oblique productus, cuneiformis, subattenuatus: margo inferior convexus, extremitatem posteriorem versus fere rectus seu parvulum insinuatus: margo lunularis concavus, arealis reclinans: depressio lunularis profunda, orato-elongata, infra acuta, marginata; depressio arealis insignis, lanceolata, marginibus rotundatis terminata: tuberos antemediani, prominuli, incurvi: cinctrix muscularis antica conspicua, postica cerni non potest.

Cast ovate-triangular, inequilateral, rather swollen, shortly and widely rounded before, behind obliquely produced, wedge-shaped, somewhat attenuate: lower margin convex, but toward the posterior end almost straight or very slightly sinuated: lunular margin concave, that of the area nearly rectilinear: lunular depression deep, ovate-elongate, sharp below; depression

corresponding to the area marked, lanceolate, limited by rounded margins: umbones ante-mesial, rather prominent, incurved: anterior muscular scar conspicuous, the posterior one not to be distinguished.

Four specimens, casts. Dimensions of those figured:—

Largest: length, 84 mm.; height, 71 mm.; thickness, 45 mm.

Smallest: " 33 mm.; " 25 mm.; " 17½ mm.

The specimens seem to belong to a species hitherto unnamed, and to be of form so peculiar that it cannot be mistaken. Comparison with an internal cast taken for the purpose, in plaster, from *Callista squatula* Sow., leaves very little doubt that the species is rightly to be referred to *Callista*, which, with Stoliczka and Zittel, I prefer to consider a subgenus of *Cytherea*.

The very brief description of *Venus indurata* Conrad (Official Report, p. 219, Pl. ix. fig. 53) corresponds fairly to these casts, but the figure cannot be recognized as representing them.

Collections Merrill and Congregational House.

Locality and Position. — Beirut district; Turonian.

Isocardia Merrilli, sp. nov.

Plate V, figs. 2 a, b, c.

Nucleus oblique trigonus, cordiformis, summe tumidus, equivalvis, inaequilateralis; extremitas anterior brevis, angulata, plus minusve truncata rotundata; margo ventris lente arenatus; extremitas posterior ab umbonibus cito planeque declivis et supra angulum infero-posteriorem truncatus: gibbositas maxima paulo postmedianus, super umbones deorsum et retrosum aduersus marginem infero-posteriorem decurrens: umbones prorsum inclinati, subterminates, infecti, ut apices acutos late separati: regio humularis excavato-cordata, dilatata, ei Isocardiae cordis Linn. persimilis: linea cardinalis ut in nucleis Isocardiae typice solet: prominentiae impressionibus musculorum anteriorum, pallii lineis et forroharum suprajacentium congruentes alter et generi proprie.

Cast obliquely triangular, heart-shaped, extremely tumid, equivalve, inaequilateral; anterior extremity short, angulated, more or less truncately rounded; ventral margin gently areuated; posterior extremity rapidly and flatly sloping and truncate above the angle formed by the ventral and posterior margins. The greatest gibbosity is a little back of the middle, beginning upon the umbones and extending along them downward and

backward towards the lower-posterior margin: umbones inclined forward and subterminal; beaks inflected and widely sundered at their apices, which are acute and in the complete shell were probably directed upward. The lunular region is excavated into a wide cordate pit, which agrees closely with that of the recent *Isocardia cor* Linn. The hinge line is represented by a thin sinuous ridge similar to that which may be seen in an artificial cast of *I. cor*. Elevations corresponding to the anterior muscular and pallial impressions, and to the little pits above the latter, show all these to have been deep and characteristic of the genus.

The four specimens, all interior casts, differ from each other but slightly, except in the shape of the posterior part, which is somewhat variable in its proportions.

The dimensions of the specimen represented by figures 2 *a, b* are: length, 61 mm.; height, 73 mm.; thickness, 72 mm.; — of that shown by figure 2 *c*: length, 62½ mm.; height, 64 mm.; thickness, 71 mm.

Collections Merrill, Congregational House, and Thomson.

Locality and Position. — Beirút district; probably from the fourth of Fraas's nine zones, that of the Turonian Cardium bed, which abounds in casts of this genus.

Cyprina orientalis, sp. nov.

Plate V, figs. 3 *a, b*.

Nucleus oblongus, inflatus, aequivalvis (?), inaequilateris: latus anticum breve, sub umbonibus emarginatum et infra emarginationem paulo productum ac subrotundatum; regio lunularis valde excavata: latus posticum elongatum, rotundate truncatum; area angusta, profunda, haud marginata: umbones adnudum prominentes, prorsum inclinati; apices magni, crassi, retorsi, incurvi, approximati: margo ventris subrectus: prominentiae impressionibus muscularum anteriorum et pallii congruentes insignes.

Cast oblong, inflated, equivalve (?), inequilateral: anterior side short, emarginate beneath the umbones, and below the emargination slightly produced and subrostrate; lunular region strongly excavated: posterior side elongate, roundly truncate; area excavated but not defined by a border: umbones very prominent and inclined forwards; beaks large, swollen, blunt, incurved, approximate: ventral margin almost straight: elevations corresponding to the anterior muscular and pallial impressions protuberant.

Single specimen, a cast. Length, 84 mm.; height, 69 mm.; thickness, 64 mm.

From figure 3 *b*, which is accurately drawn, the cast would seem to be inequivalve. Careful inspection, however, leads to the conclusion, that a force acting from above has depressed the right beak and pushed it into contact with the left,—the two originally having been somewhat separated in the cast. It is probable that the complete shell— which the deep muscular and pallial impressions show to have been thick—was equivalve, and that the beaks were closely approximate, if not actually contiguous.

This species resembles in some degree the Cretaceous *C. intermedia* d'Orb., and *C. Valungensis* Pict. and Camp., though distinct from both. Possibly it may be identical with *Isoocardia crenulata* Conrad (Official Report, p. 215, Pl. iv, fig. 26), described from “casts, all more or less distorted,” of which the author furthermore says, “The figure represents the original form as nearly as I could restore it.” Neither the description nor the figure applies with any certainty to the specimen here considered.

Fraas (Aus dem Orient, I. Theil, p. 94) regards *Isoocardia crenulata* Conrad as being *Cyprina inornata* d'Orb. Our cast is certainly distinct from *C. inornata*. Coll. Merrill.

Locality and Position.—Beirút district; probably from the zone of the Cardium bed.

Cyprina (Venilicardia?) Abeihensis, sp. nov.

Plate IV, figs. 2 a, b, c.

Testa trigono-cuneata, crassiuscula, inaequilateralis, tumida; antice ad marginem lunularem leviter insinuata et infra breviter rotundata; margo dorsi posticus primum curvatus deinde rectilineus et rapide declivis; extremitas posterior subcaudata et oblique truncata: margo ventris arcuatus et pone vix flexuosus: umbones subterminales, angustati, acuti, contingui, anterius rotundatus et inflexi: lunula fere plana, nisi supra vir excavata, verticaliter rotundato-elongata, margine acuto circumscripta: area cardinalis lanceolata, profunda, carinis subacutis terminata; extra carinas area planata a lateribus angulo obtuso oblique disjuncta: superficies concentrica tenereque striata, striis nonnullis incrementi fortioribus lamellisque seu varicibus circiter octo apud umbones instruata: carino, ut milii videtur, dentibus tribus primariis et cetera in valva dextra uno laterali, postico, elongato, recto armatus: impressiones musculares evidentes, haud profunde: margo internus tenuis, non vero crenulatus.

Shell cuneiform-triangular, moderately thick, inequilateral, tumid; in front at the lunular margin lightly sinuate and below abruptly rounded: hinder dorsal margin at first curved, then rectilinear and rapidly sloping; posterior

extremity subcaudate and obliquely truncate: ventral margin arcuate and behind slightly flexuous: umbones subterminal, angulated, sharp, contiguous, strongly turned forward: lunule almost flat, slightly excavated at the upper part, vertically roundly-elongate, bounded by a sharp margin: cardinal area widely lanceolate, deep, limited on each side by a rather sharp ridge or keel; outside of the ridges, on each side, a flattened area, separated from the convex portion of the valve by an obtuse ridge running from the beak to the postero-inferior extremity: surface marked with fine concentric striae and distant coarser lines of growth, all of which become heavier on the flat umbonal declivity, the striae being replaced upon the beaks by about eight low and regular varices: hinge apparently armed with three primary teeth, and on the right valve with a distinct, remote posterior lateral tooth, straight and elongate: muscular impressions clearly marked, but not deep: internal margin thin and not crenulated.

Two specimens:—

Larger: length, 51 mm.; height, 46 mm.; thickness, 36 mm. Coll. Bird.

Smaller: " 44½ mm.; " 38½ mm.; " 30 mm. Coll. Merrill.

It seems probable that the species figured by Fraas under the name *Astarte Libanotica* (Aus dem Orient, H. Theil, p. 45, Pl. iii, figs. 1 *a*, *b*), and said by him to be "one of the commonest shells in the horizon of the sand-stone," is identical with this. But his figures represent the ante-umbonal portion as considerably longer, the hinder extremity rounded rather than truncate, and the posterior umbonal slope as wanting the flat surface which is present in our specimens, and is bounded on one side by an obtuse ridge running from each beak to the posterior-basal angle, and on the other by the sharp ridge which limits the cardinal area. Our specimens are alike in form and proportions, and while they and Fraas's figures may represent divergent forms of one and the same species, yet since the uncertainty in this respect is in no degree removed by any verbal description, and as we cannot regard the shell as an *Astarte*, we feel warranted in describing and naming it anew.

Fraas's only semblance of description is contained in the following passage: "Characteristic of *Astarte Libanotica* are six to eight strong Astarte-wrinkles next to the umbones, but which farther upon the shell flatten out, so that it appears nearly smooth. Without the aforesaid ribs, peculiar to the genus *Astarte*, from the aspect of the shell one would sooner think of *Venus* and its related genera. Whether the margin of the shell is notched or smooth, unfortunately I cannot affirm from any of the specimens."

Although both our specimens allowed the separation of their valves, only part of the internal characters were brought to light. The cardinal teeth are completely silicified, and instead of separating were cleft, in the larger and finer specimen (the one figured) leaving a surface so irregularly fractured that the nature of this portion of the hinge is not discernible. From the left valve of the smaller enough can be distinguished to make it tolerably certain that the hinge was longer and more complicated than the short and simple hinge of *Astarte*. In the right valve of both specimens a very distinct, but peculiar, long, straight, remote, posterior lateral tooth is present, a character never found in *Astarte*. The lateral tooth of the left valve is not well preserved in either case. Being thinner than that of the right, and overlapping it externally, the tooth was injured in separating the valves. The pallial line could not be freed from hard stony deposit, and remains unknown. The muscular impressions are shallow, and with the thin and smooth inner margins of the valves, which show no traces of crenulation but have a sharp chisel-edge, they coincide closely with *Cyprina Islandica* Linn. Such a marginal edge is exceptional in *Astarte*.

Calling in the aid of external characters in the determination, it will be observed that the shells of all recent, as well as of all fossil species of *Astarte* to which doubt in respect to their classification does not attach, are considerably flattened, while the specimens in question are decidedly ventricose. And though their umbonal wrinkles or varices are very like those of *Astarte*, yet instead of covering the whole surface of the shell and growing stronger towards the ventral margin, as in most species of that genus, in these fossils the wrinkles are found only upon the beaks. But for the conspicuous external ligament, the wrinkles would suggest rather that the species belongs to *Crassatella*, in some recent species of which, as *C. Kugieola* Linn. and *C. undulata* Sow., a few strong wrinkles similar to those of our fossils appear upon the beaks and are confined to them.

Comparing the present species with *Cyprina (Veniocardia) Ligeriensis* d'Orb. (Paléont. Frac., Terr. Crét., III, p. 103, Pl. cxlxxv), one of the most characteristic species of the subgenus *Veniocardia*, it will be found that the two have lunules, areas, umbonal slopes, and in fact most of their parts, strikingly similar, the chief external difference, aside from the umbonal plaits, being that the posterior dorsal slope of *Ligeriensis* is less rapid, producing a hinder extremity higher than that of the subcaudate *Abelensis*.

Typical specimens of *Cyprina rostrata* Sow. (Trans. Geol. Soc. Lond., [2.]

IV, p. 341, Pl. xvii, figs. 1 *a*, *b*, *c*, 1836) from the Greensand of Blackdown, when compared with ours, show a resemblance equally striking. They too have, upon the beaks, concentric wrinkles similar to those of *Abeihensis*, but smaller; and the two species in other respects differ little externally, except that the anterior part of *rostrata* is somewhat longer, and its lunule deeper, though margined in the same way.

While inclined to believe that this species belongs to the family *Cyprinidae*, I refer it with less confidence to *Venlicardia*, and not without the feeling that it may prove to be a *Cypricardia*.

Locality and Position. — Vicinity of Abeih. Fraas makes his *Astarte Libanotica* to be one of four characteristic fossils of the Sandstone stage of the Cenomanian (see pp. 6, 7). If not identical with *Libanotica*, this species, which was taken from sandstone, probably belongs to the same horizon.

Cardium (Acanthocardia) Syriacum CONRAD.

Plate III, figs. 7 *a*, *b*, *c*.

Cardium Syriacum CONRAD, 1852, Official Report, p. 217, Pl. vii, fig. 45.

Nucleus oblique cordiformis, inaequilateralis, allitudine longitudinem multo superante; antice ad marginem lente curvatus, postice subrectus: declivitas posticalis abrupta, lata, appланata, sulcis umbonalibus incavata; umbones tumidi porrecti; apices antemediani, attenuati, acuminati, approximati (in testa sane contigui): regio lunularis impressionibus profundis dentium lateraliuum anteriorum notata; lunula magna, cordiformis, paululum impressa, sulco terti terminata.

Internal cast obliquely heart-shaped, inequilateral, much higher than long; gently curved at the front margin, the hinder being nearly straight: posterior slope abrupt, broad, flattened, grooved with furrows on the umbones; umbones swollen, long; beaks placed before the middle, attenuate, pointed, approximate (in the complete shell doubtless in contact): lunular region marked by deep impressions left by the anterior lateral teeth; lunule large, cordate, superficial, bordered by a slight furrow.

Twelve casts. Dimensions of the specimen figured, and of a larger imperfect cast:—

Of the former: length, 29 $\frac{1}{2}$ mm.; height, 34 mm.; thickness, 27 mm.

Of the latter: " 33 mm.; " 40 mm.; " 32 mm.

Although Conrad's description is inadequate, yet so marked is the agree-

ment in outline between the casts and his figure, taking the side view, that the propriety of referring the fossils to the species named above is manifest. But the figure must have been drawn from a cast on which the ridge caused by the filling of the posterior gape of the valves had been worn away. This, as seen in our figure, presents at the margin a straight line running obliquely downward from the obtuse angle which it forms with the hinge line. The posterior view shows curved grooves proceeding from the beaks downward and inward to the mesial ridge. These are imprints left by internal umbonal ridges, such as occur in the recent *C. consors* Sow., *C. isocardia*, Linn., and other species of the subgenus *Acanthocardia*, which ridges stamp upon plaster casts of their interiors like grooves, but less deeply impressed. The species just named, however, have no defined lunule, but their internal casts show beneath the beaks, in front, a widely cordate impression, left by the large anterior lateral teeth. The corresponding cavity in the Lebanon casts is due to a like cause, and outside of it is seen the border of a "lunule large and cordate," but very feebly impressed. Two of the casts clearly show the presence of thick-set, narrow radiating ribs. Coll. Thomson and Merrill.

Locality and Position. — Beirût district; probably from the zone of the Cardium bed.

Cardium crebriechinatum CONRAD.

Cardium crebriechinatum CONRAD, 1852, Official Report, pp. 217 and 231, Pl. vi, figs. 11-43, Pl. xv, fig. 77, and App., Pl. ii, fig. 16.

Two specimens, one with test, and nearly entire; the other an imperfect cast.

Fraas doubts the classification of this species as a *Cardium*, and is inclined to consider it to be a *Cardita*, — on what ground is not evident. Lartet thinks it may be identical with *C. sulciferum* Coquand (Géol. et Paléont. de Constantine, p. 206, Pl. x, figs. 15, 16). The forms of the two species are indeed very similar, and both are covered with radiating ribs; but upon *sulciferum* (which is much the larger of the two) the ribs are wide, while upon *crebriechinatum* they are much more numerous and very narrow. Coll. Thomson.

Locality and Position. — Found at Abeih by Fraas, and by him referred to the Gasteropod zone of that vicinity.

Cardium (Protocardia) Hillanum SOWERBY.

Cardium Hillanum SOWERBY, 1813, Min. Conch. Gr. Brit., I, p. 41, Pl. xiv, fig. 1.

Cardium biseriatum CONRAD, 1852, Official Report, p. 216, Pl. vi, figs. 38-40.

Cardium bellum CONRAD, 1852, Official Report, p. 225, App., Pl. i, fig. 3.

Fifteen specimens, all casts. Though entirely devoid of test, they are easily identified by their form alone. Impressions from some of the shell markings are often retained by the casts. Merrill, Thomson, and Congregational House collections.

Locality and Position.—Beirút district; probably from the Turonian Cardium bed.

Cardium (Protocardia) Judaicum, sp. nov.

Plate IV, figs. 5 a, b, c, d.

Testa subquadrata, subaequilateralis, paulo longior quam altior, moderate inflata; margo anticus rotundatus, posticus oblique truncatus, superne rectiusculus: umbones temidi, obtuse angulati, postice concavi; apices sere in media testa siti, prominuli, subacuti, incurvi, arte approximati: superficies lateralis variebus concentricis, regularibus, plano-convexis, levibus, quam spatia interposita latioribus, circiter tricenis oblecta; superficies postica costis radiatibus angustis, spinulis et lamellis tenissimis ornata; duodecim umbila: margo posticus usque ad angulum postero-ventralem dentatus. Signa interna ignota.

Shell subquadrate, subequilateral, a little longer than high, moderately inflated; anterior margin rounded; posterior margin obliquely truncated, above nearly straight: umbones swollen, obtusely angled, more or less concave behind; beaks nearly mesial, somewhat prominent, rather sharp, incurved, closely approximate: lateral surface furnished with about thirty regular concentric varices which upon their faces are flatly convex, smooth, and wider than the furrows between them; posterior surface marked by twelve narrow radiating ribs, which are studded with spinules set at equal distances, and are crossed by extremely delicate lamellæ: posterior margin toothed as far down as the postero-ventral angle. Characters of interior unknown.

Dimensions of the entire specimens:—

Larger: length, 21 $\frac{1}{2}$ mm.; height, 22 mm.; thickness, 18 mm.

Smaller: " 23 mm.; " 21 mm.; " 15 mm.

The three examples of this species are two entire shells retaining the test complete, and a single right valve. In the smaller entire one the surface at the posterior umbonal slope is so remarkably preserved that the minute spinules which stud the radial ribs are in part retained, and with the delicate lamellæ which cross the ribs are conspicuous under the lens. In some of the spaces between the ribs the lamellæ have all their original sharpness and perfection. Of the same specimen, shown in figs. 5 *b*, *c*, the beaks have been pressed into actual contact, while in the normal example, of which a right side view is given in fig. 5 *a*, they are separated by a small space.

Lartet (op. cit., p. 130, Pl. xi, fig. 5, and Pl. xii, fig. 9) figures, without description, under the name *Cardium Hillanum* Sow., var. *Mobilitium*, a shell which, as figured, agrees essentially with immature individuals of the typical *Hillanum* from the Blackdown Hills of Devonshire. The three specimens upon which the present species is based are obviously distinct from *Hillanum*. Comparison with a full series of the species last named from the Blackdown Greensand, and with many casts of the same from Lebanon, shows the following differences. In the side view, the outline of *Hillanum* is rotundate-cordate; of this, subquadrangular. The concentric markings of the former are numerous striae with very small intervening ridges; of the latter, wide and flattish variees, separated by well impressed furrows. The posterior umbonal slope of *Hillanum* is always flattened, while that of the species in hand is somewhat concave, and near the posterior margin is suddenly compressed, the compressed part including a straight and very gently descending hinge line.

Nor is this species *C. bifrons* Reuss (Kreideschichten in den Ostalpen, p. 145, Pl. xxviii, fig. 19, 1854), which is a variety of *Hillanum*. Our fossils most nearly resemble *C. Vattou'i* Coquand (Géol. et Paléont. de Constantine, p. 207, Pl. xi, fig. 5), which is readily distinguishable by having tubercles upon its twenty posterior radiating ribs.

Locality and Position.—The single valve, from the Merrill collection, was taken from ferruginous and arenaceous marl, and therefore cannot be referable to the Cardium zone of the Turonian, which is made up of brown limestone and contains only casts of various species of Cardium. The entire specimens, from the Bird collection, are apparently from the same kind of rock, which seems to be identical with the arenaceous marl of the Gasteropod zone, already noticed. As, according to Fraas, that zone yields fairly preserved specimens of *C. Hillanum*, it is not improbable that this species is from the same horizon.

Gonodon? hebes, sp. nov.

Plate IV, figs. 1 a, b, c, d.

Testa subquadrata, ventricosa, crassissima, pavum inaequilatera, rugulis incrementi modicis irregularibus obducta: latus anticum perbrere, truncatum rotundatum, posticum longius, altum, rotundato-angulatum, fere verticaliter truncatum: umbones antemediani, turgidi, retusi, incurvi: lunula nulla aut parva et illimitata: specimenis unici umbonum caecumina absumpta; area ligamentalis cardinisque pars magna exesa: utriusque valve dens cardinalis anticus trigonus, robustus, latus, superne profunde concurvus; margines intus laeves. Ceteræ notæ cerni non possunt.

Shell subquadrate, ventricose, moderately thick, somewhat inequilateral, covered with irregular wrinkles of growth of inconsiderable size: anterior side very short, truncately rounded, hinder side the longer, high, obliquely angled by an obscure rounded umbonal ridge, almost vertically truncated: umbones antimesial, swollen, blunt, incurved: lunule none or small and undefined: tips of umbones of the single specimen decayed; ligamentary area and larger part of the hinge removed by corrosion; under the beak of each valve a wide, strong triangular tooth, deeply concave above and prolonged in the direction of the longitudinal axis of the shell. The other characteristic marks cannot be distinguished.

Single specimen, with test. Length, 37 mm.; height, 34 mm.; thickness, $28\frac{1}{2}$ mm.

Of the solitary example, the beaks in part, the whole area, and the greater portion of the hinge have been removed by decay. Beneath the beak in each valve remains a remarkably prominent triangular tooth, deeply hollowed upon its inwardly sloping wide upper face. These teeth are quite unlike any others of which I have knowledge, and it is difficult to give a correct idea of them either by a figure or in words.

The peculiar form, together with the concentrically wrinkled surface and the somewhat enlarged lunular margin, indicates the relationship of this shell to that group of the *Lucinidae* to which the genus *Unicardium* belongs. The abnormal development of the two remaining hinge-teeth forbids that it should be referred to any genus of that group except *Gonodon*. Since the work* which contains Schafhaeutl's original diagnosis of that genus is wanting in the libraries of Cambridge and Boston, I have it only as given by

* Sud-Bayerns Lethaea Geognostica, 1863.

Stoliczka and Zittel, briefly, and as respects the teeth not very clearly. I have therefore given a generic name to this shell with much doubt, especially as *Gonodon* has hitherto been known only from Jurassic strata. Coll. Merrill.

Locality and Position. — Beirût district; from a yellow arenaceous marl, probably Turonian.

Cardita lacunar, sp. nov.

Plate V, figs. 1 a, b, c, d, e.

Tesla parva, orbiculato-quadrangularis, paulo longior quam allior, tumida, inaequilateralis, umbonibus obliquis incurvis approximatis antemedianis instruela: margo anticus insinatus, rotundatus, posticus abrupte truncatus, cardinalis retrorsum lente declivis, ventralis æqualiter arenatus: superficies costis radiantibus quaternis denis compressis squamosis eleganter insculpta; squamæ suberectæ, rotundæ, imbricatae; interstitia lata, profunda, in valva sinistra duo posteriora lamellæ transversis specie lacunarium dirisa: lumulu parva, cordiformis utrinque excavata, medio parum elevata: signa interna incognita.

Shell small, roundish-quadrangular, a little longer than high, tumid, inequilateral, furnished with oblique, incurved, closely approximate antemesial umbones: anterior margin insinuate, rounded, the posterior one abruptly truncate, the hinge margin gently sloping backward, the ventral regularly areuated: surface elegantly sculptured with fourteen radiating, compressed sealy ribs; the scales suberect, round at the end, imbricate; interspaces of the ribs wide and deep, the hinder two upon the left valve divided by transverse lamellæ after the manner of lacunaria: lumule small, cordate, excavated on each side, elevated in the middle. Characters of the interior unknown.

Five examples, almost uniform in size, and all retaining the test entire. Length, $8\frac{1}{2}$ mm.; height, $7\frac{1}{2}$ mm.; thickness, 6 mm.

In all the specimens the posterior cardinal margin of the left valve is conspicuously higher than that of the right; and the interspace of the hindmost two ribs of the same valve is divided by delicate and flexuous transverse lamellæ into four-sided pits, panels, or compartments, widest in proportion to their length toward the beaks and narrowing downward. This structure, which suggested the specific name, is upon the right valve barely indicated, never complete. Coll. Bird.

Locality and Position. — Probably from the vicinity of Abeih, and from the Turonian marl.

Hippurites plicatus CONRAD.

Plate III, fig. 8.

Hippurites plicatus CONRAD, 1852, Official Report, p. 234, App., Pl. vii, fig. 49.

Two specimens, apparently of this species. The one figured is a free lower valve: height, 68 mm.; greatest width, 45 mm. The other is a cluster of aggregated individuals, upon one of the imperfect shells of which a single upper valve is present. This is in place, and, so far as it is distinguishable in the mass, has the general form and about one fourth the height of the figured lower valve, with its apex central and directed upwards. Coll. Merrill.

Locality and Position. — Beirút district; probably from the same horizon as the species next following.

Hippurites Lewisii FRAAS.*Hippurites Lewisii* FRAAS, 1878, Aus dem Orient, II. Theil, p. 74, Pl. v, figs. 5 a, b.

A single lower valve, entire and answering fairly to Fraas's description and figures. Height, 65 mm.; greatest width, 60 mm. Whether this and *plicatus* are distinct species may perhaps be doubted. Coll. Thomson.

Locality and Position. — Probably the Beirút district; assigned by Fraas to the Cardium bed of the Turonian (see pp. 6, 7).

Trigonia Syriaca CONRAD.*Trigonia Syriaca* CONRAD, 1852, Official Report, pp. 214 and 232, Pl. iii, figs. 19, 20, 21, 23, and App., Pl. iv, fig. 26.*Trigonia Syriaca* FRAAS, 1878, Aus dem Orient, II. Theil, p. 43, Pl. iii, figs. 2-5.

Seven specimens. Three with both valves nearly entire; one single right valve; three casts. Fraas's figures of the exterior of this species are far better than Conrad's.

The best shells and casts — two of each — are from a private collection of Professor Louis Agassiz, and are labelled only "Lebanon." The others are from the Merrill collection.

Locality and Position. — Probably from the Beirút district. Fraas styles this the "leading fossil" of the Cenomanian Sandstone.

Nucula (Cucullella?) Palæstina, sp. nov.

Plate VI, figs. 5 a-i.

Testa parva, subcylindrata, duplo longior quam altior, maxime inaequilatera et ventricosa, crassitudo altitudini fere adæqua; antice attenuata submueronata; extremitas postica paulo compressa, acuta; margo dorsi antice insinuata, postice paululum declivis; margo ventris antice subsinuata, postice aequaliter arenata: umbones humiles inconspicui, androrum inclinati: lunula superne angulo acuto apicum definita, inferne vix limitata: superficies striæ concentricis tenuibus confertissimis notata: carbo multidenticulatus; linea cardinalis obtusangula.

Shell small, subcylindrical, twice as long as high, exceedingly inequilateral and ventricose, the thickness almost equalling the height; attenuate and submueronate in front; hinder extremity a little compressed, sharp; dorsal margin sinuated before, behind very gradually sloping; ventral margin subsinuate in front, posteriorly regularly areuated: umbones low, inconspicuous, inclined forward: lunule defined above by the acute angle formed by the beaks, below scarcely limited: surface marked by delicate concentric striae, very closely set; hinge multidenticulate; hinge-line obtusely angled.

Thirty-three specimens, all with test entire. Length, 13 to $15\frac{1}{2}$ mm.; height, $7\frac{1}{2}$ to $8\frac{1}{2}$ mm.; thickness, 7 to $8\frac{1}{3}$ mm.

Of the whole number only a single specimen allowed the test to be removed, leaving the east with all its markings distinct, except the anterior slope of the hinge line, which is partially obscured, but evidently toothed. The muscular impressions are shown to be deep and somewhat angular, the pallial line simple and rather distant from the ventral margin. The anterior boundary of the umbones is more conspicuously angular and prolonged in the east than in specimens covered by the test. A little behind the beaks of the east a groove runs from the dorsal margin almost vertically downward (slightly backward) about 2 mm. It is divided lengthwise into two grooves by a ridge along its middle. In *Cucullella* McCoy,* according to the diagnosis, "a strong internal septum [clavicle] extends from before the beaks to the posterior margin of the anterior adductor, forming a deep slit in the easts." Our east indicates the existence of a channelled septum (within the test)

* Zittel (Handbuch der Palæontologie, I. Band, 2. Abtheilung, p. 53) regards *Cucullella* McCoy (Annals and Magazine of Natural History [2], VII, p. 50, 1851) and *Cleidophorus* Hall (Palæontology of New York, I, p. 300, 1847) as identical. Both are palæozoic.

which runs almost vertically downward from a point a little *behind* the beaks. Shall the diagnosis of *Ctenella* be changed to include the present species, or shall the species be excluded from the group?

Zittel (Die Bivalven der Gosaugebilde in den Nordöstlichen Alpen, Wiener Akademie, Denkschriften Math. Naturwiss., XXIV, pp. 162-164, 1865), Meek (Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, p. 98, 1876), and some others, following Deshayes, have considered the shorter and generally truncated side of the shell of *Nucula* to be the posterior rather than the anterior part, the beaks to be directed backward, and what seems to be the lunule as really corresponding with the esutcheon (area) of other types. But Zittel (Handbuch, I. Band, 2. Abtheilung, p. 52, 1881) has returned to the older and more common view, which we have followed in our description of this species.

N. cylindrica McCoy (Synopsis of Carboniferous Limestone Fossils of Ireland, p. 69, Pl. xi, fig. 26, 1844) is a closely related species. Finally, *N. submucronata* Conrad (Official Report, p. 213, Pl. ii, fig. 14) based upon a cast much larger than our specimens, may possibly be identical with this species. But as his figure and description of the cast do not represent an internal ridge to be present, and as specimens with the test were unknown to Conrad, we have regarded it as necessary to publish our examples under a new name. Coll. Bird.

Locality and Position.—The cast above mentioned and specimens broken to show the mode of mineralization have the same peculiar pyritiferous composition which was found in the Jurassic Ammonites from the Ormati Clay of Mejdel esh Shems. Of the different collections considered in this paper, no fossils known to be Cretaceous exhibit this kind of mineralization. We may therefore infer that the species is probably from the locality and formation which furnished the Ammonites referred to.

Leda decussata, sp. nov.

Plate VI, figs. 4 a, b, c.

Testa orato-subtriangulata, antice inflata, postice attenuata, rostrata; umbones parvi, incurvi, contigui, medium pâne testam teneentes; lunula acute elliptica, fere plana, obscure marginata; area profunde excavata, lira edita lata rotundata terminalis; angulus cardinalis obtusus; superficies striis concentricis regularibus crenatis, aliis radianibus nimbis decussatis, insculpta, sub vitro venusta.

Shell ovately triangular, inflated in front, behind attenuate, rostrate : umbones nearly mesial, small, incurved, contiguous ; lunule sharply elliptical, obscurely margined ; area deeply excavated, bounded by a rounded, broad, elevated ridge ; angle of hinge line obtuse : surface engraved with crowded regular concentric striae decurrent by minute radial striae, and presenting a beautiful appearance under the lens.

Three specimens. Dimensions of that which is in best condition, and figured : length, 12 mm.; height, 8 mm.; thickness, $6\frac{1}{2}$ mm.

This species in form and superficial markings so closely resembles *L. venusta* Sauvage and Rigaux (Journal de Conchyliologie, XIX, p. 356, 1871; XX, p. 180, Pl. xi, fig. 7, 1872), from the *Kimmeridgicn moyen de Brèquerieques*, that in the outset I was strongly inclined to look upon it as a variety of *venusta*. But on further examination it seems necessary to set it apart as a distinct species, on account of the following differences. The French specimens are smaller, their three dimensions being given respectively as 7, 4, and 3 mm.; they have the anterior margin rounded, and the surface of the sides *radiatim costellata et concentrica striata* (op. cit., XIX, p. 356), or, *ornée de côtes rayonnantes nombreuses et de stries concentriques* (op. cit., XX, p. 181). The Lebanon shells, on the other hand, have their dimensions about twice greater than those of *venusta*: viz. 12, 8, and $6\frac{1}{2}$ mm.; the front margin slopes in a nearly straight line; and the surface is engraved with close-set, well-impressed concentric striae, crossed, not by *costae* nor *costellar*, but by radial striae so delicate as to be visible only with aid of the lens. So also the Jurassic *L. lacryma* Sow. sp., has very nearly the form of this species, but is distinguished from it in being smaller, more prolonged posteriorly into a narrow rostrum, and in having its surface marked with "concentric striations, rather remote, and faintly impressed, sometimes undistinguishable" (Morris and Lyett. Mollusca from Great Oölite, Part II, p. 53, Pl. v, figs. 15, 15 a, 1853). Coll. Bird.

Locality and Position. — Fraas records from the Ornati Clay of Mejdel esh Shems, under the name of *Nuenia lacryma* Sow. (Jahrbuch für Mineralogie, etc., 1877, p. 27, and Aus dem Orient, II. Theil, p. 19, 1878), a species which in all probability is the one here described. The general similarity of the two species has already been noticed above. One of our three specimens has the test partly broken away, showing within a cast having the pyritiferous composition mentioned in connection with the species last described. For reasons there and here stated, it is probable that these specimens of Leda are from the Ornati Clay of Mejdel esh Shems.

Cucullæa (Trigonoarca) Ligeriensis D'ORBIGNY sp.

Area Ligeriensis D'ORBIGNY, 1844, Paléont. Franç., Terr. Crét., III, p. 227, Pl. ccexvii.

A single internal cast, whose identity is proved by comparison with several excellent and authentic casts from the Turonian of Sarthe, and the *Craie chloritée* (Upper Greensand) of Rouen.

Length, 64 mm.; height, 37 mm.; thickness, 41 mm.

In form this species is very similar to, if not identical with, *A. Passyana* d'Orb., 1844 (Paléont. Franç., Terr. Crét., III, p. 241, Pl. ccexvii, figs. 1, 2), of which, at the time of publication, d'Orbigny knew only the cast. Fraas (Aus dem Orient, I. Theil, p. 89) speaks of *A. brevifrons* Conrad (Official Report, p. 215, Pl. v, fig. 31) as closely resembling *A. Passyana*; but if Conrad's figures of Syrian species of *Area* are at all to be relied on, *Passyana* and *Ligeriensis* approach nearest to *A. indurata* Conrad (op. cit., p. 216, Pl. v, fig. 33), and may be identical with it. Coll. Merrill.

Locality and Position. — Beirut district; from the Turonian.

Cucullæa (Trigonoarca) concinna GOLDFUSS sp.

Plate VI, figs. 7 a, b, c.

? *Cucullæa Munsterii* ZIETEN, 1830, Versteinerungen Würtembergens, p. 75, Pl. lvi, figs. 7 a-c.

Area concinna GOLDFUSS, 1838, Petrefacta Germaniæ, II, p. 148, Pl. exxiii, figs. 6 a, b.

Cucullæa concinna QUENSTEDT, 1852, Handbuch der Petrefactenkunde, p. 526, Pl. xlvi, fig. 27.

Thirteen specimens, varying much in size, of which the largest is figured. Length, 8½ to 15 mm.; height, 6½ to 9 mm.; thickness, 4 to 7 mm.

These specimens agree perfectly with examples from the *Marnes oxfordiennes* of Salins, and with Goldfuss's description and figures. Numerous specimens from de Koninek's collection, now in the Museum of Comparative Zoölogy, and labelled by him "*Area (Cucullæa) Munsterii* Zieten," from the *Lias moyen* of Balingen, as well as Zieten's figures of his own species, differ from specimens of *concinna* Goldf. from Lebanon and elsewhere, and from Goldfuss's and Quenstedt's figures of the same, only in lacking the anterior radial lines, which upon some examples of *concinna* are very obscure. *Cucullæa concinna* Phillips, 1829 (Geology of Yorkshire, Part 1, p. 109, Pl. v, fig. 9), from the Oxford Clay of Scarborough (figured as 33 mm. long, and 15 mm. high), bears strong likeness to the smaller *concinna* Goldf. in form and markings. *Munsterii* Goldf., as figured in Petrefacta Germaniæ, is distinct from *Munsterii* Zieten.

Of eight lots in the Museum collections, from the Lias and Oxford Clay of Europe, and bearing the names given in the synonymy above, all are pyritiferous, as are our Lebanon specimens; and from the coincidence of the latter with the European specimens in their peculiar mineralization, condition of surface, and even color, all might be supposed to have come from one and the same deposit. All alike seem to have lost from the test a thin outer layer, portions of which are retained on a single specimen from Salins. Coll. Bird.

Locality and Position.—Ummistakably Jurassic, and probably from the Ornati Clay of Mejdel esh Shems.

Perna orientalis, sp. nov.

Plate VI, figs. 1 a, b, c.

Testa cuneato-subquadrata, subaequivalvis, attilio longitudinem multo superans, antice crassa, postice evanescens et in alam brevem productus: margo cardinalis obliquus, rectiusculus; area cardinalis interna lata, canaliculis parallelis ligamentum multiparitum exipientibus circiter novem incurvata; canaliculi spatiosi interjectis latiores: umbones terminales, acuti, aduncii, approximati: margo anticus insinuatus; sinus byssi latius, profundus, rugosus: superficies lateralis valvarum lamellis incrementi tenuissimis induita: impressio muscularis subcentralis valde excavata.

Shell cuneately subquadrate, subequivalve, height greatly exceeding the length, anteriorly thick, behind compressed and produced into a short imperfect wing: hinge margin oblique, nearly straight; internal hinge area broad, grooved with about nine parallel furrows, constituting a series, which receive the many-parted ligament; the furrows wider than the intervening spaces: umbones terminal, sharp and hooked: anterior margin sinuated; byssal sinus broad, deep, rugose: sides of the valves overlaid with very thin lamellae of growth: muscular impression nearly central and remarkably deep.

Two specimens: one nearly entire, the other a single left valve. Dimensions of entire shell: length, 32 mm.; height, 53 mm.; thickness, 32 mm. Dimensions of single valve: length, 35 mm.; height, 62 mm. (originally about 66 mm.); thickness, 23 mm.

This species is proportionally much thicker in front, and has a relatively wider and deeper byssal sinus than any hitherto described. As seen from the side, its outline somewhat resembles *P. mytiloides* Lam., which, however, in all specimens and figures known to me, is comparatively flat and thin, and

has the lateral surface of its valves covered with few and wide lamellæ; while those of our examples are numerous, narrow, and exceedingly thin, the anterior edges only of the valves being rugose. The test is exceptionally thick and massive, and in the single valve the muscular impression is a deep pit with an abrupt bounding wall on the front side.

Neither Conrad, Lartet, nor Fraas records any species of fossil *Perna* as occurring in Syria, nor did Coquand meet with the genus in Algeria, where the prevailing formation is Cretaceous. It is worthy of note, too, that Pietet and Campiche failed to detect *Pernæ* in the Cretaceous of Sainte Croix, Switzerland, that Meek found none in the Cretaceous and Tertiary of the Upper Missouri country, that Ferdinand Roemer found none in the Cretaceous of Texas, and that but a single species has been recognized in the Cretaceous of all India. On the other hand, d'Orbigny gives five species as belonging to the Cretaceous of France, and Reuss describes three from the Cretaceous of Bohemia. Species are numerous in the Jurassie. Coll. Bird.

Locality and Position. — If Jurassie, as they have the appearance of being, the fossils are probably from Mejdel esh Shems.

Perna tetragona, sp. nov.

Plate VI, fig. 2.

With the specimens described under the last title was a right valve, from the thin lower and posterior margins of which small portions have been broken away. This valve so closely resembles the others in its sharp and hooked beaks, in the narrow and delicate lamellæ upon the lateral surfaces, and in the width, depth, and rugosity of the byssal sinus, that, taking into account the wide range of variation which is observed in recent species of *Arciculidae*, it is possible that this is only a variety of *orientalis*.

Yet the thin, flat, quadrangular form of the valve, the absence of any deep or distinctly limited muscular impression, the hinge margin nearly horizontal in direction, while that of the other specimens is abruptly sloping, and the ligamental grooves narrower than their interspacess, constitute distinctive characters so striking, that, if found to be constant in specimens hereafter to be discovered, they will require the establishing of a new species, to which we have given provisionally the name placed above. Coll. Bird.

Locality and Position. — Doubtless the same as for the last species.

Vola Syriaca CONRAD sp.

Plate V., figs. 4 a - e.

Junira Syriaca CONRAD, Official Report, p. 230, App., Pl. i, fig. 6.

A single specimen, in so much better condition than Conrad's type, that it is here figured anew. The specimen is almost absolutely perfect, except for the loss of the posterior ear, and of part of the other. It shows that what, in his excellent description, Conrad calls "wrinkles" upon the ribs, are more correctly thin erect scales of small height, and that upon the concave or left valve they run more or less obliquely across the ribs and the intervals between the ribs. On the convex or right valve the scales cross the ribs at right angles with their length, but are hardly perceptible in the interspaces. In each of the five spaces between the six larger ribs which characterize the right valve are four smaller ribs, of which the two middle ones exceed the outer in size. Coll. Bird.

Locality and Position.—Conrad's type was found at Abeih, whence this probably came. Related species are found in the zone of *Ammonites Syriaeus*, and this may be from the same horizon.

Vola tricostata COQUAND sp.

Junira tricostata COQUAND (DION BAYLE), 1862, Géol. et Paléont. de Constantine, p. 219, Pl. xiii, figs. 3, 4
" " LARTET, 1875, Expl. Géol. de la Mer Morte, p. 136, Pl. xi, fig. 16.

A lower (right) valve, incomplete, but showing well the characteristic features of the species; viz. six principal radiating ribs, the intervals of which contain each three unequal intermediate ribs, the median rib being always stronger than the other two. Coll. Thomson.

Locality and Position.—Beirút district. Fraas knew the species from Muktarah in the same district, and refers it to the zone of *Ammonites Syriaeus*. Coquand assigns it, in Algeria, to *les assises rhotonagiennes*.

Vola Dutruei COQUAND sp.

Junira Dutruei COQUAND, 1862, Géol. et Paléont. de Constantine, p. 219, Pl. xiii, figs. 1, 2
" " LARTET, 1875, Expl. Géol. de la Mer Morte, p. 137, Pl. xi, fig. 18.

An imperfect lower (right) valve, which exhibits fairly the proportions and arrangements of the ribs characteristic of the species. Coll. Thomson.

Locality and Position.—Beirút district. Not known to Fraas, but found by Lartet *assez répandue en Palestine*. Since Coquand refers it, in Algeria, to the same horizon (*l'étage rhomagien*) with the last species, like that it is probably from the zone of Ammonites *Syriacus*, in Lebanon.

Vola sp.?

A single incomplete lower valve, less convex than the last two and proportionally wider. Length, about 45 mm.; height, about 50 mm. The ribs are about twenty in number, and are wide, except those of the anterior and posterior sides, which are narrower. All are very flat, and would entitle the species to the name of *Vola planicosta* if the specimen were complete enough to warrant a specific description. The upper (left) valve is unknown to us. Coll. Merrill.

Locality and Position.—Beirút district; from a chalky marl, probably Senonian.

Ostrea Syriaca? CONRAD.

Ostrea Syriaca CONRAD, Official Report, p. 212, Pl. ii, fig. 12.

Two complete specimens of a small Oyster, adhering to each other and giving evidence of having been attached at the umbones. They answer better to the description of this species than to that of any other. Greater diameter of the larger, 47 mm.; of the smaller, 45 mm. Coll. Thomson.

Locality and Position.—Probably from the Beirút district; from a yellow marl, Turonian.

Ostrea (Alectryonia) alicula, sp. nov.

Plate VI, figs. 3 a, b, c.

Testa obliquè cuneiformis; valva superior fere plana, ad cardinem versus paululum convexa et concentrica tenuiter lamellosa, alioquin vix concava et plicis radiatibus latis demissis nonnunquam dichotomis notata; valva inferior alte fornicata, umbone producto affixa, costis angustis acutis crebris dichotomis munita.

Shell obliquely cuneiform; upper valve nearly flat, towards the hinge somewhat convex and concentrically delicately lamellose, for the rest slightly concave and having the lamellæ crossed by wide, low, radiating folds, sometimes dichotomous; lower valve highly arched, affixed by the elongated umbo, and furnished with narrow, sharp, close-set dichotomous ribs.

Two specimens, both figured. Dimensions of the right-hand individual of the doublet: length, 16 mm.; height, 40 mm.; thickness, 15 mm.

This species might be mistaken for *O. virgata* Goldfuss, were it not that, in accordance with Goldfuss's description and figures, all specimens of that species which have come under my observation have the upper valve flat and concentrically wrinkled, without the radiating folds and slight concavity which are seen in the Lebanon specimens. *O. virgata*, moreover, is on record as strictly a Tertiary species, while the fossils before us clearly antedate the Tertiary period.

I suspect this to be what Fraas has figured from part of a lower valve (Aus dem Orient, II. Theil, p. 46, Pl. ii, fig. 3) as *O. succini* Fraas, concerning which the explanatory text accompanying the figure is only the following: "*Ostrea succini* is so characteristic in the whole of southerly Lebanon as an associate of the Amber, that we name the Oyster from the accompanying mineral. It is a small ribbed Oyster which is nearly like the Jurassie *O. subserrata* or *costata*, and is always swollen with a broader basis. The specimen figured is one of the largest, which we found in the neighborhood of Djebâa. Usually there is a whole colony of such Oysters together, and grown to one another." Fraas names this as one of four species characteristic of the Cenomanian Sandstone, the second of the nine members into which he divides the Cretaceous strata of Lebanon.

Of at least two different Oysters which Conrad with some hesitation describes and figures under the name *O. virgata* (Official Report, pp. 212 and 230, Pl. i, figs. 6-8, and App., Pl. i, fig. 8), from the Cretaceous district of Bhamdûn, one is perhaps the species here considered, though an upper valve supposed to belong to it is drawn without radiating folds.

Since Fraas's figure of the fragment of a single valve, without an adequate description accompanying it, gives no certainty in the case, I find myself obliged to present the species under a new name, though loth to add to the maze of fossil Oysters. Coll. Bird.

Locality and Position. — Beirût district; from an arenaceous bed which is probably the Cenomanian Sandstone.

Ostrea (Exogyra) flabellata? GOLDFUSS.

Exogyra flabellata, GOLDFUSS, 1834, Petrefacta Germaniae, II, p. 38, Pl. lxxxvii, figs. 6 *a*, *b*.

Ostrea flabellata, D'ORBIGNY, 1842, Paléont. Franç., Terr. Crét., III, p. 717, Pl. ccclxxv.

Two well preserved lower valves: one complete and having greater diameter 101 mm.

These specimens coincide with d'Orbigny's figures of *O. Boussingaultii* d'Orb. (Paléont. Franç., Terr. Crét., III, p. 702, Pl. ccclxviii), and with Conrad's figures of two very imperfect valves to which he gives the same name (Official Report, p. 213, Pl. ii, figs. 10, 11). But that species was regarded by d'Orbigny as "propre aux couches inférieures de l'étage néocomien" (loc. cit.), of the existence of which formation in the Lebanon region there is at present no evidence. D'Orbigny says also of the species as compared with *flabellata*: "Les rapports sont si intimes que je n'aurais pas balancé à réunir ces deux espèces, si elles avaient appartenu à la même couche; mais l'*O. Boussingaultii* se trouvant dans l'étage néocomien, elle est séparée de l'*O. flabellata* par les étages aptien et albien qui ne la renferment pas; aussi est-il impossible d'en suivre la filiation." (loc. cit.)

Lartet affirms (Expl. Géol. de la Mer Morte, p. 138) that the Oysters from Kerak, east of the Dead Sea, identified by Conrad and Fraas (Aus dem Orient, I. Theil, p. 86) as *O. Boussingaultii*, are in reality *O. flabellata*. In the second part of the same work, p. 79, Fraas, influenced perhaps by Lartet's opinion, for which he always manifests great respect, assigns to the species *flabellata* the related Oysters found in Lebanon.

Out of deference to these views, I have named my specimens as above, with some doubt, which is not diminished by the fact that Zittel assigns *O. Boussingaultii* to the subgenus *Amphibonda*, and *O. flabellata* to the subgenus *Exogyra*! Coll. Merrill.

Locality and Position.—From the Beirût district. Fraas refers *O. flabellata* to the zone of Ammonites *Syriaeus*, or the Middle Turonian.

UNDETERMINED.

The cast from the Merrill collection, represented in Plate IV by figures 4 *a*, *b*, is certainly not a *Lucina*. In the projection upon the posterior (?) part of each valve (largest on the right), fig. 4 *b*, it approaches *Arcopagia*, for example the species *remix* Linn.; but I am not prepared to refer it to that group.

BRACHIOPODA.

Terebratula biplicata Brocchi sp.

Anomia biplicata Brocchi, 1814, Conchologia Fossile Subapennina, p. 469, Pl. x, fig. 8.

Terebratula biplicata SOWERBY, 1815, Min. Conch. Gr. Brit., I, p. 201, Pl. xe, and V, p. 53, Pl. xxxvii, figs. 2, 3, 1825.

" " D'ORBIGNY, 1847, Paléont. Franç., Terr. Crét., IV, p. 95, Pl. dxi, figs. 9-15.

" " DAVIDSON, 1852-55, Monogr. Brit. Foss. Brach., I, Pt. ii, p. 55, Pl. vi, figs. 1-49.

Three specimens, complete, of the form represented by Davidson's figures 8 and 9. Coll. Bird.

Locality and Position. — Vicinity of Abeih; referred by Fraas to the Glandarius zone of the Cenomanian, the lowest of his nine zones of Lebanon strata. D'Orbigny speaks of the species as "caractéristique des coquilles les plus inférieures de l'étage cénomanien." (loc. cit.) Davidson states that in England it is found in the Gault, Upper Greensand, and Lower Chalk; upon the Continent, in the Gault and Upper Greensand.

Rhynchonella concinna SOWERBY sp.

Terebratula concinna SOWERBY, 1815, Min. Coneh. Gr. Brit., I, p. 192, Pl. lxxxiii, fig. 6.

" " Vox Buch., 1838, Class. et Deser. des Térebrat., Mém. Soc. Géol. France, III, p. 144, Pl. xiv, fig. 14.

Rhynchonella concinna D'ORBIGNY, 1847, Prodrome, I, p. 315.

" " DAVIDSON, 1851-52, Monogr. Brit. Foss. Brach., I, Pt. III, p. 88, Pl. xvii, figs. 6-12.

Five specimens, in the best condition and of typical form, admirably figured by von Buch. Four adult, one younger. Coll. Bird.

Locality and Position. — Fraas recognized this well-known European species in the Older Brown Jura bed of Mejdel esh Shems, whence these specimens were probably obtained. D'Orbigny refers the species to his Bathonian stage. Davidson mentions it as "abundant in the Great Oolite of many localities in England." (loc. cit.)

ALPHABETICAL INDEX.

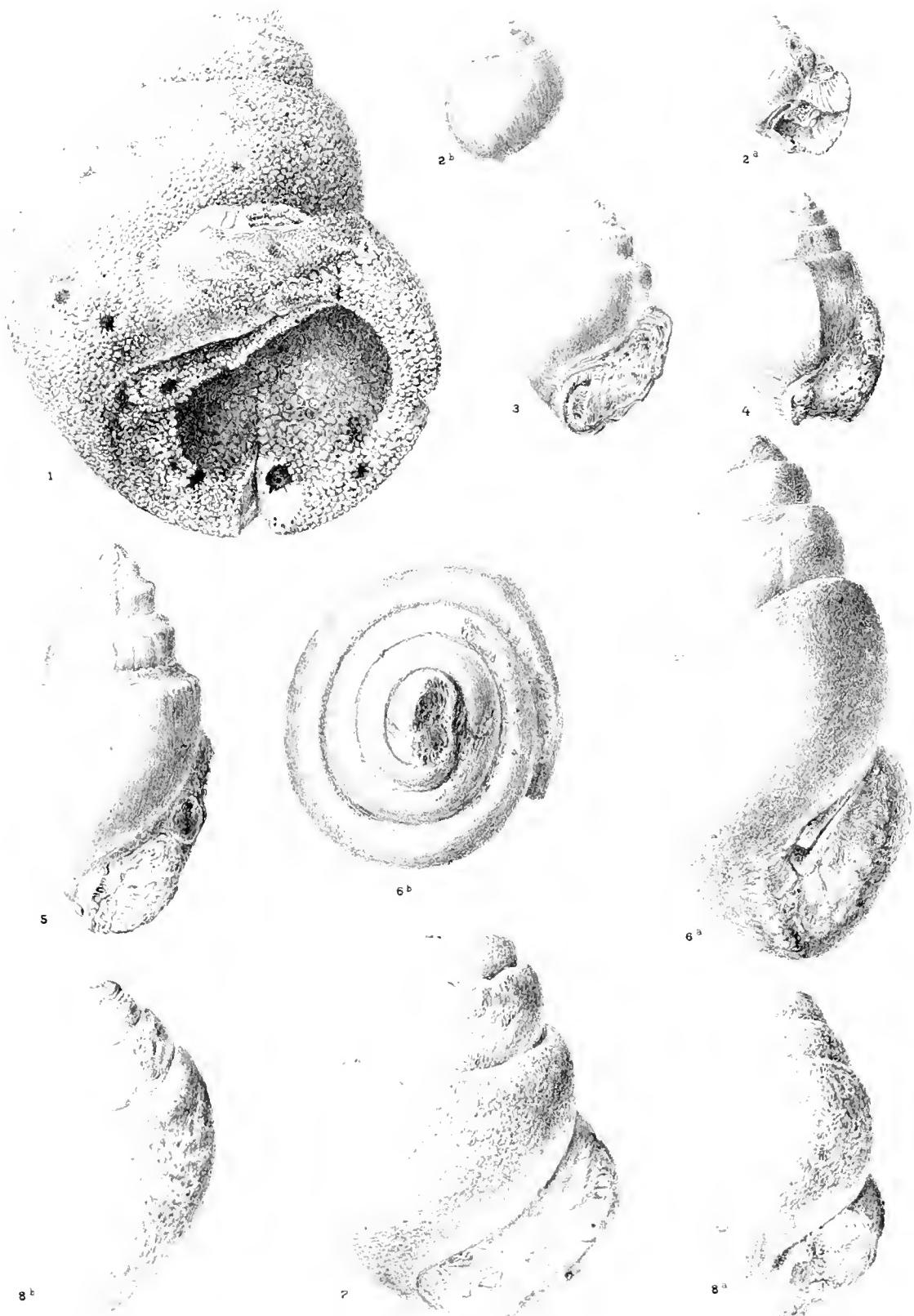
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PLATE I.

[All figures on this Plate are of natural size.]

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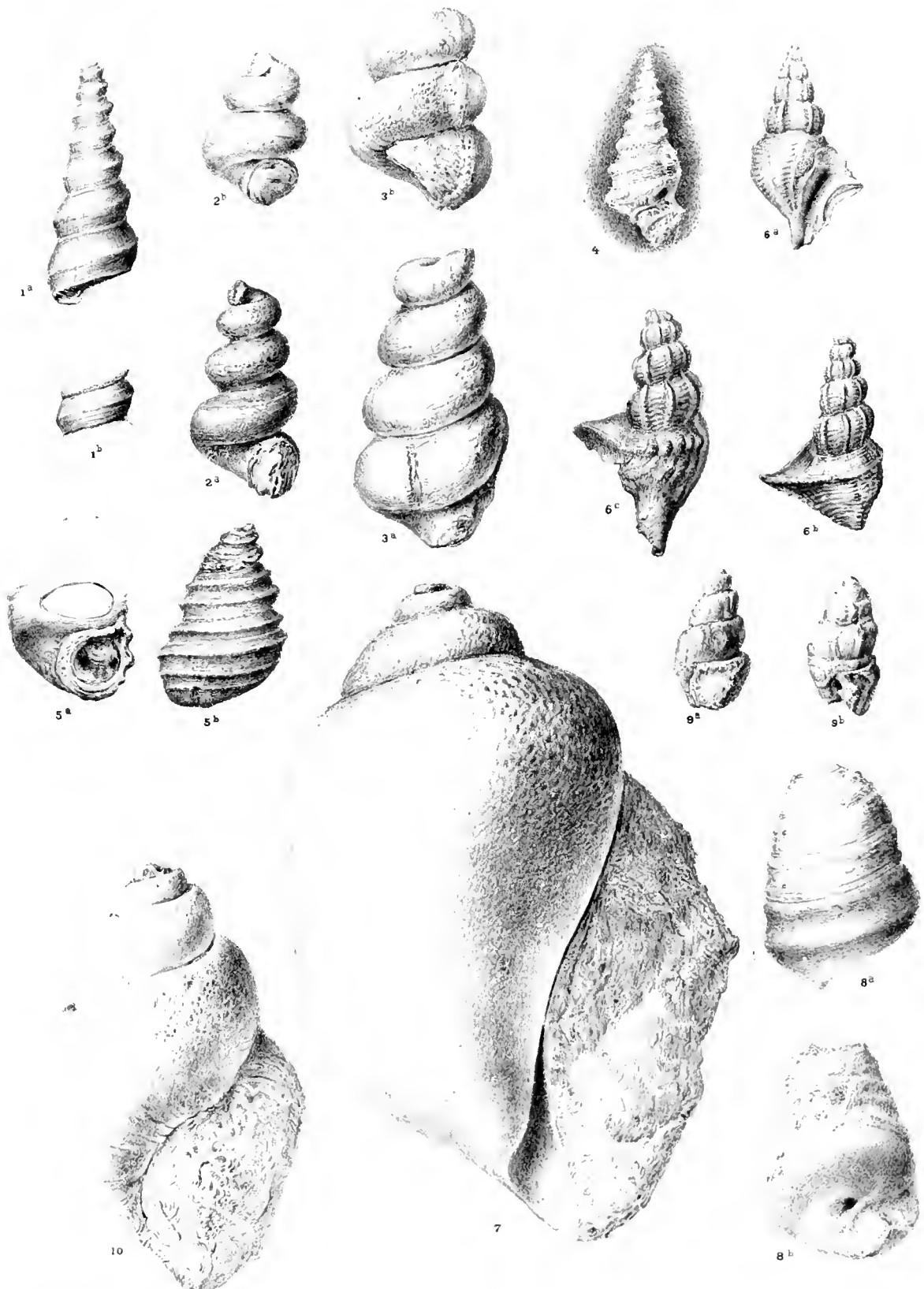


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Fraas's figures reproduced.	
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View of flatter side of a well-preserved lower valve. Natural size.	

NOTE.—The wood-cut of *Cerithium gracilens*, p. 36, represents, in natural size, an imperfect specimen, partially restored by means of smaller specimens which retain features obscured in the original of the figure. The row of indistinct tubercles on the base of the last whorl was overlooked by the artist.



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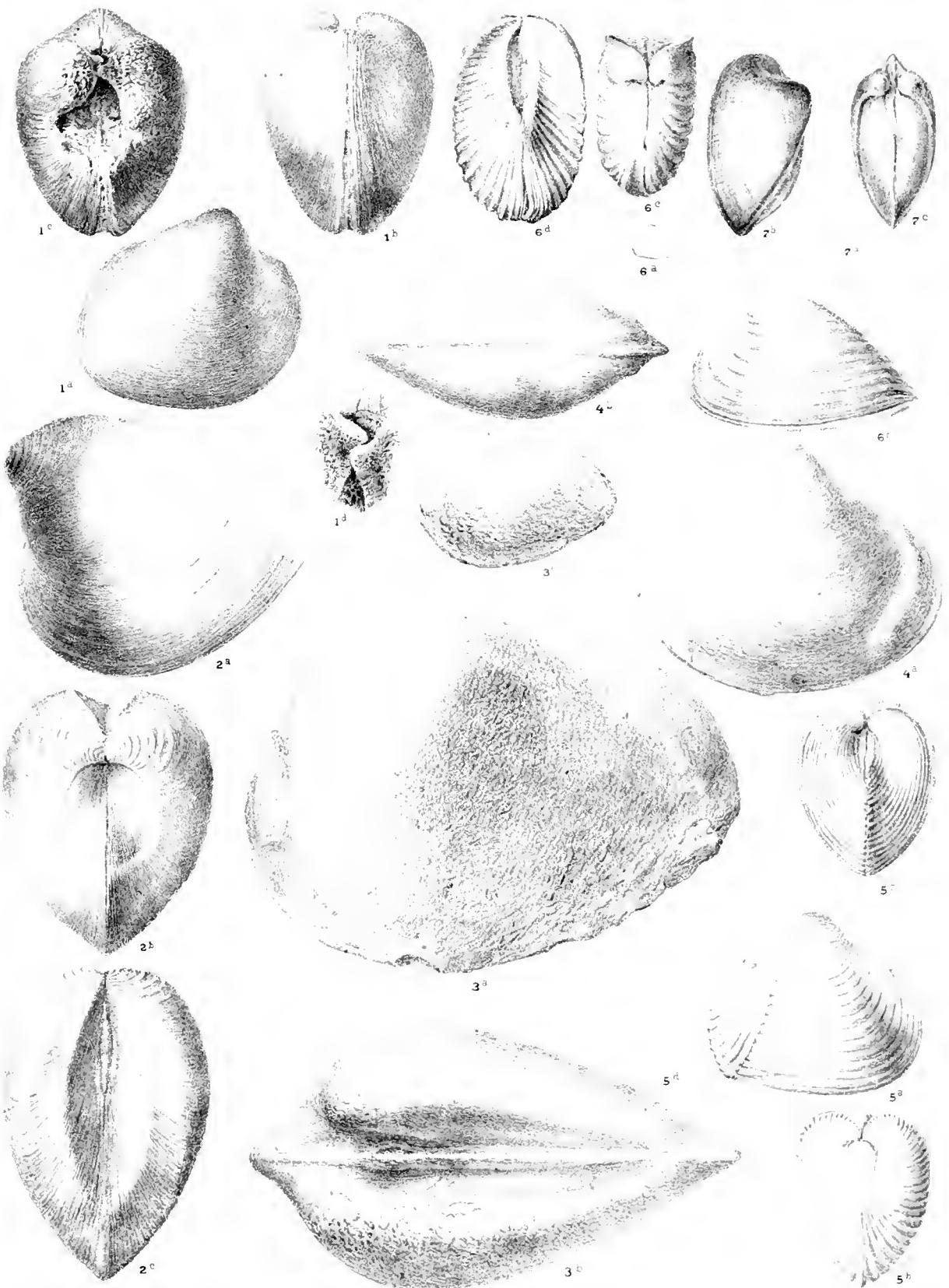


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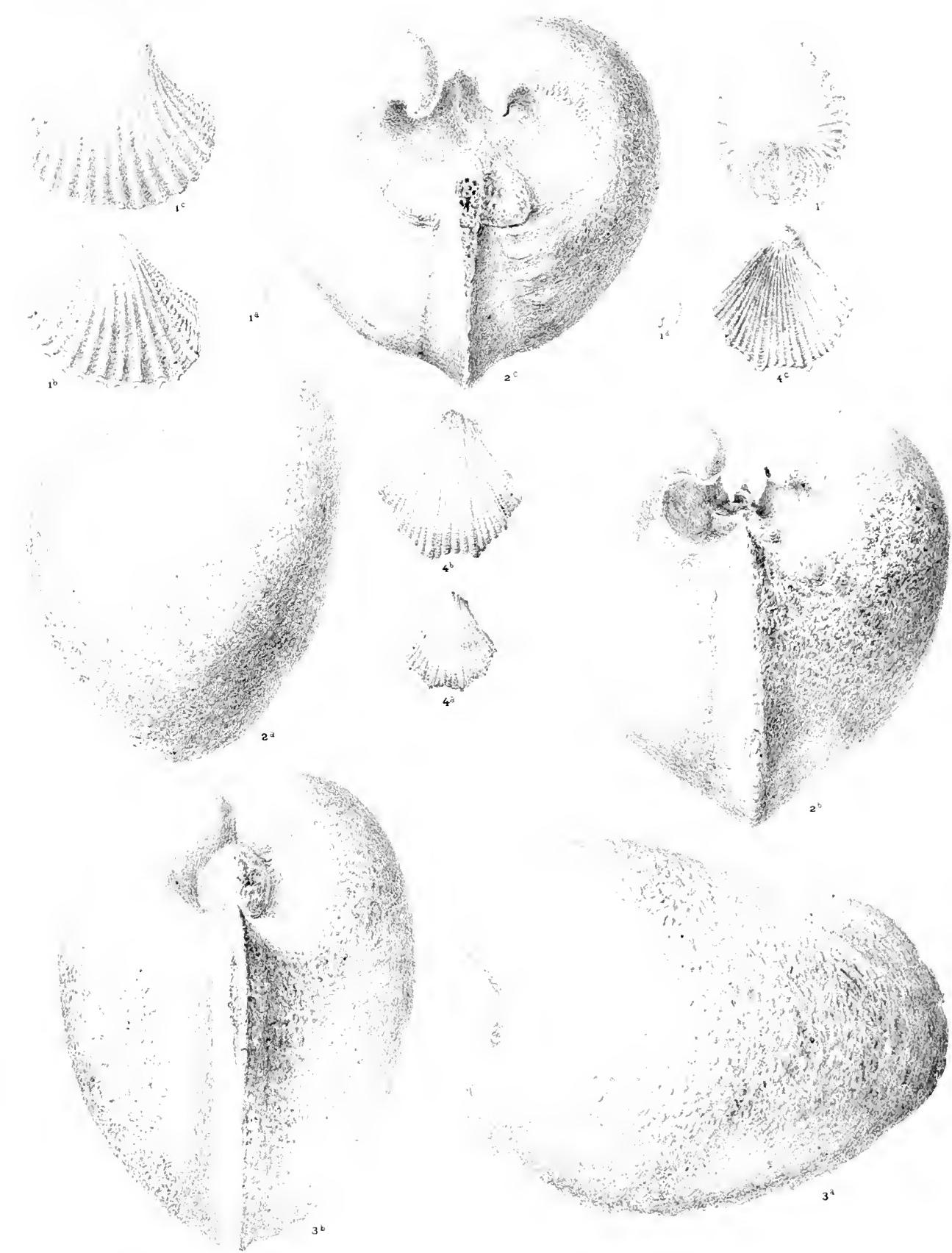
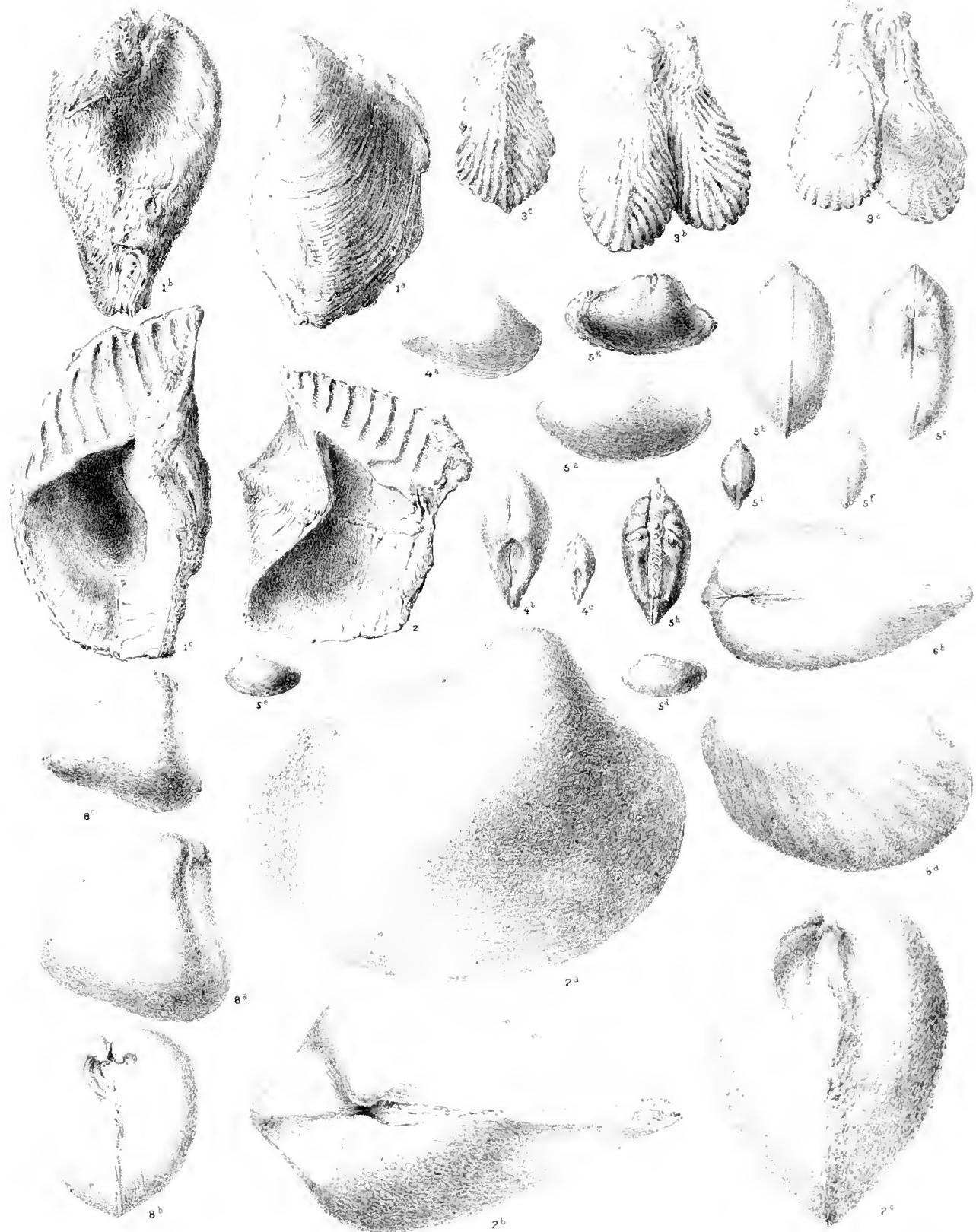


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8 a. Right side view of cast.	
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8 c. Right side view of smaller cast.	Natural size.



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